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THE CEPHALOPODA OF THE NEOCOMIAN BELEMNITE BEDS OF THE SALT RANGE.

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PLATES I TO XXV.

THE CEPHALOPODA OF THE NEOCOMIAN BELEMNITE BEDS OF THE SALT RANGE.

By

L. F. SPATH, D.Sc., F.G.S.

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CONTENTS.

THE CEPHALOPODA OF THE NEOCOMIAN BELEMNITE BEDS OF THE SALT RANGE.

BY

L. F. SPATH, D.Sc., F.G.S.

(With Plates I to XXV and 1 Text-Fig.)

I. INTRODUCTION.

The majority of the fossils described in this memoir were collected by Mr. E. R. Gee in the course of his surveying work in the Salt Range, west and east of the Indus, at a number of localities which are discussed in a separate chapter (III). The collection, when sent to me through the kind intervention of Mr. Gee, consisted of 472 ammonites and 190 belemnite fragments, but the number accounted for in the descriptions below is smaller, because many of the fragments were either unrecognisable or else pieces of broken ammonites, numbered separately, that could be fitted together. Conversely, many additional belemnite fragments embedded in the matrix of some of the ammonites were discarded as useless, the glauconitic rock often being a veritable belemnite "battle-field".

After this first collection had already been worked out, in ignorance of the existence of more material, I received a second consignment of cephalopods, collected by Messrs. E. R. Gee and N. K. N. Aiyengar, and consisting of 84 ammonites and 248 belemnites. There was only one new species, but some of the additional examples proved useful because they confirmed the tentative identifications of some doubtful or isolated fragments in the first collection, especially those from the Jurassic Limestone below the Belemnite Shales. The remainder were duplicates of the species previously described, especially the forms of *Olcostephanus* of which there were 32 or nearly 40 per cent. of the ammonites in the second collection.

Finally, after this second collection also had been incorporated in the account, there arrived a set of Neocomian fossils from the Chichali Pass which had been collected by Wynne many years ago, and which had been partly described by the late Dr. Raimund Folgner.[1] His death, in 1916, while in captivity in Russia, resulted in the collection being returned to Calcutta by the Palæontological Institute of the University of Vienna after the war, together with lengthy but fragmentary manuscript notes in German by Dr. Folgner. By the permission of the Director of the Geological Survey of India I have been able to illustrate also this additional material. It consisted of 182 ammonites (53 per cent. of them species of *Olcostephanus*) and 58 belemnites, in addition to a few lamelli-

[1] This is the fauna referred to by Baumberger (Die Kreidefossilien von Dusun Pobungo etc., Sumatra; *Gedenkboek Verbeek, Verh. Geol. Mijnbouwk. Gen. v. Nederl. & Kol.*, Geol. Ser., pt. viii, 1925, p. 38) who saw it in Vienna in 1914. I am at a loss to discover which of the ammonites could have been the species of *Craspedites* cited by Baumberger.

branchs and gastropods, the revision of which will be undertaken by Dr. L. R. Cox.

From Dr. Folgner's brief and incomplete introduction, it appears that he began his investigation in the autumn of 1908 (when he was barely twenty) and, after one "rather long interruption", resumed it in 1912. There are no descriptions of some of the species he made, and others are not in the collections, while some examples are labelled with names different from those used in the manuscript and the rough notes, part of which are in shorthand. Most of the chapters listed in a table of contents, such as stratigraphical, palæogeographical and general conclusions, are also missing, so that only the descriptions of certain species could perhaps have been utilised for translation and publication if they had been suitable. Those species, however, not represented in my two earlier collections, that were described by Dr. Folgner at length and with great care, would not have fallen easily into the divisions I had adopted when dealing with the first collections. Dr. Folgner's descriptions, altogether, were 25 years out of date, for our knowledge of Lower Neocomian faunas has made rapid advance; and my interpretation of such genera as "*Solgeria*", *Favrella*, etc., that had been recorded by Dr. Folgner, differed very considerably from his. In the circumstances I have entirely re-described the seven species that seemed to me to be new, and where I have had occasion to quote from Dr. Folgner's notes due acknowledgment is made. Two chapters, on the Hoplitids of the Lower Cretaceous of the Salt Range and on the sub-groups of the genus "*Astieria*" respectively, which seemed more complete and more suitable for publication than the rest of the notes, have also been omitted since they mostly restated the opinions held by Uhlig, Kilian and other masters of Neocomian ammonites a quarter of a century ago. Nevertheless, I must pay tribute to the excellence of Dr. Folgner's work, who although so young, had the advantage of doing it under Uhlig's supervision. And I particularly endorse the following passage in his introduction in which he directed attention to the difficulties of the recognition of new species when dealing with foreign material. "Many species are represented by only a single specimen", he wrote, "and yet had to be dealt with separately and, in part, given new names. Comparison with European species was often utterly impossible and thus there was no foundation on which to build. To the probable objection of making too many species I reply that the creation of new names in many cases is preferable to the relegation of these forms to species which are distinct in definite characters of sometimes greater, sometimes less, importance. Thus in the genus *Astieria* several new species have been introduced; they differ, perhaps, some might say, in an unessential, yet a striking feature from the other species; and they must be separated so long as no transitions are known. I am in the same position as Kitchin and I expect the same reproaches from Kilian and Wegner."

Unfortunately, the preservation of many of the ammonites is far from satisfactory, as will be seen from the plates; but thanks to the fact that the former Director of the Geological Survey of India, Dr. L. L. Fermor, and after his retirement the present Director, Dr. A. M. Heron, have kindly given

me a free hand with the illustrations, some of the poorly preserved forms could be figured in a sufficient number of examples to make them recognisable. A few small (Tithonian) specimens are preserved in limonite (after pyrite), but the great majority are in a brittle, phosphatic, calcareous or glauconitic matrix, generally adhering firmly to the ammonites and not allowing of much preparation. The fossils also show signs of having been rolled, and are generally much corroded on one side. In consequence many of the identifications had to be tentative and of 84 species no fewer than 48 are more or less doubtful, while 29 are new, and only seven could be definitely attached to known forms. Nevertheless the study of these cephalopods has yielded interesting results, as will be shown in the final chapters.

The few additional specimens[1] utilised, to give as complete an account of the cephalopod fauna of the Belemnite Beds of the Salt Range as possible, came from small collections in the British Museum (Natural History), partly material collected by Dr. Fleming and others many years ago, partly presented more recently by Mr. T. O. Morris (1934) and Mr. E. S. Pinfold (1935). Some early Cretaceous ammonites kindly sent to me by Dr. Besairie, the Director of the Geological Service of Madagascar, have also proved very useful for correlation, because the Salt Range fossils, though coming from a comparatively small thickness of belemnite beds, obviously included elements of different dates. There was little to help me in the way of descriptions of similar faunas from other countries outside Europe; for the prolific South and Central American Lower Cretaceous ammonite faunas are rather distinctive and the fossils of the Spiti Shales, the only deposit that included at least some comparable elements, were collected and (necessarily) described without regard to zonal distribution. The forms collected from the "Belemnite Beds" of Baluchistan, of Thal, the Attock District, the Hazara and Samana Ranges, and the Himalayan Gieumal Sandstone, even if identical with some of the Salt Range forms, are too few and too incompletely known to assist in the enquiry; and consequently the assemblage described in the present work includes not only a considerable number of cephalopods new to science, but many curious elements which in the present state of our knowledge, and considering the fragmentary nature of most of the ammonites, cannot be satisfactorily placed within the three or four ammonite families that were dominant in earliest Cretaceous times. I have taken the opportunity to discuss the systematics of some of these and to revise certain genera; but the feeling remains that we are as yet far from knowing the full story of geological events which determined the baffling successions of ammonite faunas of the end of the Jurassic and beginning of the Cretaceous to which reference is made in the concluding chapter.

To avoid unnecessary repetition, only the locality numbers are given in the descriptions of those ammonites that were collected by Mr. E. R. Gee. The letters B. M. (with a number) refer to the specimens preserved in the British Museum (Natural History). The use of *cf.* (*conformalis*) and of *aff.* (*affinis*) in the determinations of some uncertain or incompletely known forms is the

[1] A small assemblage, noticed on p. 122, was received after the present work was already in proof.

same as in previous publications[1]; *cf.* expresses doubt, but *aff.* indicates obvious affinity, though not identity.

In conclusion I desire to express my cordial thanks to Dr. L. L. Fermor and Mr. Gee for asking me to undertake the description of this interesting fauna and to Dr. W. D. Lang, the Keeper of the Geology Department of the British Museum (Natural History), for affording me every facility for temporary storage of the collection and for the use of material in his charge; also to Mr. A. Reeley of the same department for his constant help in many ways.

[1] Monograph of the Ammonoidea of the Gault. Pt. 1. *Pal. Soc.*, p. 10 (1923).

II. DESCRIPTION OF SPECIES.

A. AMMONOIDEA.

Family : *LYTOCERATIDAE.*

Sub-family : *HEMILYTOCERATINAE*, Spath, 1927.

Genus : PTEROLYTOCERAS, Spath, 1927.

This family is represented by a single example of *Pterolytoceras ? punjabense* (Folgner MS.) nov., provisionally referred to this genus. The mere fact that at one time it had been identified by Dr. Folgner with *Lytoceras exoticum*, Oppel sp. (=*Amm. alatus*, Blanford) seemed to indicate its systematic position. Uhlig[1] in 1903 referred *L. exoticum* to the group of *L. eudesianum*, for which in 1905 Buckman[2] created the genus *Thysanolytoceras*. The definition of this genus, however, does not apply to *L. exoticum ;* for *Thysanolytoceras* was stated to comprise the shells in which the general ornamentation resembled that of *Lytoceras*, Suess s. s. (*fimbriatum* group, including *Fimbrilytoceras* and *Kallilytoceras*, Buckman, 1918 and 1921), while the crenulated flares were more of the pattern of those of *Thysanoceras*, Hyatt (*cornucopia* group, including *Crenilytoceras* and *Orcholytoceras*, Buckman, 1926), without, however, agreeing with either. *Thysanolytoceras*, so common in the Upper Jurassic, has not only numerous flares, but they are separated by a considerable number of fine striae which are fimbriate and conspicuous in the young, but become less distinct at larger diameters. In *Pterolytoceras*, on the other hand, the reclined flares are only feebly crenulate at the base, and the intermediate striae are so fine at all stages that the shell appears almost smooth. It is possible that *Lytoceras fraasi*, Dacqué, which I formerly included in *Hemilytoceras*, is an early species of *Pterolytoceras*.

The Salt Range form here described has intermediate ribs which are cut by spiral lines, producing a lattice structure as in *Thysanoceras*, so that its inclusion in *Pterolytoceras* is provisional. *Hemilytoceras*, Spath,[3] 1927, however, with its strongly projected trumpet-shaped flares and depressed whorl-section is still more distinct. It is necessary to restrict *Hemilytoceras* to such species agreeing with the genotype (*H. immane*, Oppel sp.) as for instance *H. atrox* (Oppel) and *H. municipale* (Oppel) ; but it is to be noted that the former (*H. atrox*) was described by Zittel[4] as a variety (*strambergensis*) of *Lytoceras liebigi* and that Gignoux[5] took that species to include for example *L. lepidum* (d'Orbigny), perhaps the young of *L. subfimbriatum* of the same author. I thus used to include in *Hemilytoceras* also forms like *L. sutile* (Oppel) with similar young stages ; but like *L. rex*, Waagen, *L. sutile* could, perhaps, be more appropriately referred to

[1] Fauna of the Spiti Shales. *Pal. Indica*, Ser. XV, Vol. IV, fasc. 1, p. 8.

[2] Certain Genera and Species of Lytoceratidae. *Quart. Journ. Geol. Soc.*, Vol. LXI, p. 149.

[3] Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch). *Pal. Indica*, N. S., Vol. IX, No. 2, Pt. 1, p. 64.

[4] Cephalopoden der Stramberger Schichten. *Pal. Mitteil.*, Vol. II, Pt. 1. p. 74, Pl. XI. fig. 3 (1868).

[5] Les Lytoceratidés du Paléocrétacé. In Kilian ; Contributions à l'Étude des Céphalopodes paléocrétacés du S. E. de la France. *Mém. Explic. Carte géol. dét. France*, p. 107 (1920) 1921.

Thysanolytoceras, though the true *H. montanum* (Oppel), but perhaps not the Kachh species, is probably a fore-runner of the typical *immane* group.

Now there are many transitions between the forms just discussed, especially their younger stages, and the Neocomian types that I would include in *Eulytoceras*, Spath, 1927. These range from *L. inaequalicostatum* (d'Orbigny), perhaps also only the young of *L. subfimbriatum* (d'Orbigny), to *L. phestum* (Matheron), and include for example the East African *L. mikadiense* (Krenkel) and *L. hennigi* (Zwierzicky), cited below; and they are characterised by their rather distinct costation, with or without periodical flares, but no constrictions or at least no conspicuous constrictions such as distinguish the Protetragonitidae. It seems to me that the Salt Range form is less close to *Eulytoceras* than to *Pterolytoceras*, but the depth of the external lobe is not here considered to be a diagnostic character, since the external lobe is generally far longer in the young than in the adult, a phenomenon seen in many other ammonites and known already to Zittel and Uhlig.

The latter author[1] stated that it was well known that with the beginning of the Cretaceous, a large number of curious *Lytoceras* types appeared which had no ancestors in the Jurassic. Among his "fimbriate" forms, however, there were not only species that I include in *Eulytoceras* (*E. phestus*, *E. raricinctum*, *E. subfimbriatum*, *E. anisoptychum*, etc., some of them transitional to *Costidiscus*, Uhlig), but a Protetragonitid (*Hemitetragonites crebrisulcatum*) in addition to doubtful forms like *Lytoceras julietti* (d'Orbigny) and *L. densifimbriatum*, Uhlig, which is probably a form of *Ammonoceras* (Lamarck) Chenu. The latter includes some of the most typical and most fimbriate of the Cretaceous Lytoceratids, but becomes rarer and rarer in the higher beds of the Cretaceous. Unlike *Lytoceras* s. s. and *Metalytoceras* (group of *L. triboleti* [Hohenegger MS.] Uhlig), however, these genera have no bifurcating or branching ribs.

1. Pterolytoceras (?) punjabense (Folgner MS.) sp. nov.

Plate XIX, figs. 1*a*, *b*.

Diagnosis.—Subplatygyral, subpachygyral, sublatumbilicate. Whorl-section almost perfectly circular, whorls scarcely touching. Ornamentation consisting partly of principal ribs, fairly evenly spaced and radial, with fimbriate ridges, as in *Thysanolytoceras eudesianum* (d'Orbigny)[2], but the intervening subsidiary ribs are cut by spiral lines, so that a lattice structure is produced, as in *Thysanoceras orbignyi*, Buckman[3]. This ornamentation is pronounced only on outermost layer of test. On the inner whorls some indistinct constrictions are visible on the cast. The cast of the body-chamber is perfectly smooth. Length of body chamber and mouth-border unknown. Suture-line with the external lobe nearly as deep as the first lateral lobe. Second lateral lobe low and deeply indented. Saddles with very slender stems, the external being slightly narrower

[1] Cephalopoden-Fauna der Wernsdorfer Schichten. *Denkschr. K. Akad. Wiss. Wien*, Vol. XLVI, 2, p. 183 (1882).
[2] Pal. Franç., Terr. Jurass., 1846, p. 386, Pl. CXXVIII.
[3] *Ibid.*, p. 316, Pl. XCIX (*Amm. cornucopiae*).

but higher than the first lateral saddle. Small auxiliary lobes after short second lateral saddle on the umbilical slope.

Measurements.

Diameter	63 mm.
Height of last whorl	37 %
Thickness of last whorl	35 %
Umbilicus	43 %

Remarks.—The only known example includes part of the body-chamber and is in an excellent state of preservation. Before giving it the MS. name here adopted Dr. Folgner apparently included this form in *Lytoceras exoticum*, Uhlig,[1] since he listed it under that name in a MS. table of species (the label bearing still another MS. name). But he pointed out in his description that Uhlig's species, though the closest ally of *L. punjabense*, was more evolute and slenderer and lacked the characteristic reticulate ornamentation, while the stronger principal ribs were also more widely and irregularly spaced. In reality, Uhlig's species, which has been described in great detail, and for which I created the genus *Pterolytoceras*, is so much like the present form that separation is now provisionally suggested merely on the strength of the spiral ornamentation which has not yet been observed in *L. exoticum*, but perhaps only because of defective preservation. Conversely, since only the bases of some of the characteristic flares are preserved in the present form, it is impossible to state whether the crests of these were fimbriate as in *Thysanolytoceras* or plain and reflexed as in *Pterolytoceras*.

Folgner also compared the present species to *Lytoceras fimbriatum* (Sowerby) d'Orbigny (=*L. post-fimbriatum*, Prinz), but this Lower Liassic form, recently discussed[2], is not only provided with deep constrictions, but has an entirely different ornamentation. *L. subfimbriatum* (d'Orbigny) and its var. *kochi*, Somogyi[3] may look much like the present species, especially when they are preserved as internal casts, but *L. densifimbriatum*, Uhlig, also cited by Folgner, is less closely comparable, while *L. phestus* (d'Orbigny), with more numerous principal ribs, but without sign of collars, has a different whorl-section. Of the other two species with which Folgner had compared the present species, *L. mikadiense*, Krenkel,[4] has no spiral lines; and judging by actual topotype examples of Krenkel's species in the British Museum of Natural History (Nos. C. 38073-75), that form as well as its close ally *L. hennigi*, Zwierzicky,[5] shows the close principal ribs that characterise *L. phestus* (d'Orbigny) which I previously included in the genus *Eulytoceras*.

The second form cited by Folgner, namely *Lytoceras batesi*, Trask, in Stanton's[6] interpretation, is distinguished by its numerous fine and crenulated ribs.

[1] Fauna of the Spiti Shales, fasc. 1, p. 14, Pl. I, figs. 3-4 (1903).

[2] Spath: The Ammonites of the Green Ammonite Beds of Dorset. *Quart. Journ. Geol. Soc.*, Vol. XCII, p. 441 (1936).

[3] Das Neokom des Gerecse Gebirges. *Mitteil. Jahrb. k. ungar. geol. Reichsanst.*, Vol. XXII, Heft 5, p. 318; text-fig. 3, p. 319 (1916).

[4] Die untere Kreide von Deutsch-Ostafrika. *Beitr. Pal. Geol. Österr.-Ungarn*, Vol. XXIII, p. 223, Pl. XXII, fig. 5 (1910).

[5] Die Cephalopoden-Fauna der Tendaguru Schichten in Deutsch-Ostafrika. *Archiv für Biontologie*, Vol. III, Pt. 4, iii, p. 40, Pl. IV, figs. 6-7 (1914).

[6] The Fauna of the Knoxville Beds. *Bull U. S. Geol. Surv.*, No. 133, p. 75, Pl. XIII, figs. 9-11 (1895) 1896.

It might even be a form of the *subfimbriatum* group, like the Valanginian species recently recorded by Besairie.[1]

Horizon.—Neocomian (?), Belemnite Beds (base ?).

Locality.—Malla Khel (1),[2] apparently together with *Blanfordiceras* (see under No. 30).

Family : ***HAPLOCERATIDAE***, Zittel, emend. Spath.

Genus : NEOLISSOCERAS, Spath, 1923.

2. NEOLISSOCERAS GRASIANUM (d'Orbigny).

(Plate I, figs. 4*a-d*.)

1840. *Ammonites grasianus*, d'Orbigny ; Pal. Française, Terr. Crét., Vol. I, p. 141, Pl. XLIV.

1849. *Ammonites grasianus*, d'Orbigny ; de Zigno : Nouvelles observations sur le terrain crétacé de l' Italie septentrionale. *Bull. Soc. géol. France* (2), Vol. VII, p. 30.

1860. *Ammonites grasianus*, d'Orbigny ; Ooster : Catalogue des Céphalopodes fossiles des Alpes Suisses, Pt. IV, p. 102.

1860. *Ammonites grasianus*, d'Orbigny ; Pictet and Campiche : Déscription Foss. Terr. Crét. Environs Ste. Croix. *Matér. Pal. Suisse*, sér. 2, Vol. II, Pt. 1, p. 357.

1861. *Ammonites grasianus*, d'Orbigny ; de Loriol : Déscription des fossiles du Mont Salève (in Favre : Recherches géologiques dans les parties de la Savoie, du Piémont, et de la Suisse voisine du Montblanc), p. 27.

1867. *Ammonites grasianus*, d'Orbigny ; Pictet : Mélanges paléontologiques, II, p. 74, Pl. XIII, fig. 1.

1868. *Ammonites grasianus*, d'Orbigny ; Pictet : Mélanges paléontologiques, IV, p. 233.

1868. *Ammonites grasianus*, d'Orbigny ; Zittel : Cephalopoden der Stramberger Schichten. *Pal. Mitteil.*, Vol. II, Pt. 1, p. 77.

1868. *Ammonites grasianus*, d'Orbigny ; Winkler : Versteinerungen aus dem bayerischen Alpengebiet, etc. I. Neocom d. Urschlauer Achenthales, etc., p. 12.

1870. *Haploceras grasianum* (d'Orbigny) Zittel : Fauna der älteren Cephalopoden-führenden Tithon-Bildungen. *Palaeontographica*, Suppl., p. 49.

1879. *Haploceras grasianum* (d'Orbigny) Vacek : Über Vorarlberger Kreide. *Jahrb. k. k. geol. Reichsanst.*, Vol. XXIX, p. 738.

1882. *Haploceras grasianum* (d'Orbigny) Mallada : Sinopsis paleontologica de Espana. Cretaceo. *Bol. Com. Map. geol. Espana*, Vol. IX, Pl. IV, figs. 6-7.

non 1882. *Haploceras grasianum* (d'Orbigny) Uhlig : Zur Kenntnis der Cephalopoden der Rossfeldschichten. *Jahrb. k. k. geol. Reichsanst.*, Vol. XXXII, Heft 3, pp. 388, 393.

1884. *Haploceras grasianum* (d'Orbigny) Zittel : Handbuch der Palæontologie, Vol. I, Abt. II, Lief. 3, p. 465.

1885. *Haploceras grasianum* (d'Orbigny) Herbich : Date paleontologice din Carpatii romanesti. I. Sistemulu cretacicu in basinulu isvoreloru Dambovitii. *Ann. Biur. geol.*, an. III, p. 217 (1888).

[1] Recherches géologiques à Madagascar. *Bull. Soc. Hist. Nat. Toulouse*, Vol. LX, fasc. 2, p. 554, Pl. XIII, fig. 3 (1930).

[2] Numerals within brackets denote the number of specimens from each locality.

1887. *Haploceras grasianum* (d'Orbigny) Uhlig: Über neocome Fossilien vom Gardenazza in Südtirol, etc. *Jahrb. k. k. geol. Reichsanst.*, Vol. XXXVII, p. 104.

1889. *Haploceras grasi* (d'Orbigny) Kilian: Montagne de Lure. Thèse. Paris, p. 202.

1890. *Haploceras* (*Desmoceras*) *grasianum* (d'Orbigny) Toula: Geologische Untersuchungen im östlichen Balkan, etc.. *Denkschr. k. Akad. Wiss. Wien.*, Vol. LXXV, p. 394.

1890. *Haploceras gratianum* (d'Orbigny) Parona: Sopra alcuni fossili del Biancone Veneto. *Atti. R. Ist. Veneto*, Vol. XXXVIII (Ser. VII, Vol. 1), Pt. 4, p. 294.

1890. *Haploceras grasi* (d'Orbigny) Toucas: Étude de la Fauna des Couches tithoniques de l'Ardèche. *Bull. Soc. géol. France*, sér. 3, Vol. XVIII, p. 593.

1896. *Haploceras grasi* (d'Orbigny) Blayac: Sur le Crétacé inférieur du Bassin de l' Oued Cherf (Algérie). *C. R. Acad. Sci. Paris*, Vol. CXXIII, p. 959.

1898. *Haploceras grasi* (d'Orbigny) Simionescu: Studii geologice si paleontologice din Carpatii sudici. *Acad. Rom. Publ. Fond V. Adamachi*, No. II, p. 123.

1900. *Lissoceras grasi* (d'Orbigny) Paquier: Recherches géologiques dans le Diois et les baronnies orientales. *Trav. Lab. géol. Grenoble*, Vol. V, p. 90.

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1900. *Haploceras grasi* (d'Orbigny) Simionescu: Synopsis des Ammonites néocomiennes. *Trav. Lab. géol. Grenoble*, Vol. V, p. 142.

1901. *Haploceras grasianum* (d'Orbigny) Sarasin and Schöndelmayer: Etude monographique des Ammonites du Crétacique inférieur de Châtel-Saint-Denis. *Mém. Soc. pal. Suisse*, Vol. XXVIII, p. 21.

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1902. *Lissoceras grasi* (d'Orbigny) Karakasch: Note sur le Crétacé inférieur de Biassala (Crimée). *Trav. Lab. géol. Grenoble*, Vol. VI, p. 98.

1907. *Lissoceras grasianum* (d'Orbigny) Pervinquière: Études de Paléontologie Tunisienne, I. Céphalopodes des Terrains Secondaires. Text and Atlas, Paris, p. 113.

1907. *Haploceras* (*Lissoceras*) *grasi* (d'Orbigny) Baumberger and Heim: Palæontologisch-stratigraphische Untersuchung zweier Fossil-horizonte an der Valangien-Hauterivien-Grenze, etc., *Abh. Schweiz. pal. Ges.*, Vol. XXXIV, p. 25.

1909. *Haploceras* (*Lissoceras*) *grasi* (d'Orbigny) Baumberger: Fauna der unteren Kreide im westschweizerischen Jura. *Abh. Schweiz. pal. Ges.*, Vol. XXXV (1908), p. 40.

1910. *Lissoceras* (*Haploceras*) *grasianum* (d'Orbigny) Kilian: in Frech; Lethaea geognostica, Vol. II. Mesozoicum, Vol. III, Pt. 1, fasc. 2, p. 174, Pl. II, fig. 3.

1910. *Lissoceras* (*Haploceras*) *grasianum* (d'Orbigny) Kilian: La Faune des Couches à *Hoplites boissieri* du S. E. de la France. *C. R. Ass. franç. Av. Sci.*, Congrès de Lille, p. 479.

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1915. *Lissoceras grasianum* (d'Orbigny) Kilian and Reboul: Sur quelques Ammonites de l'Hauterivien de la Bégude. In Kilian: Contribution à l'étude des faunes paléocrétacés du S. de la France. *Mém. Explic. Carte géol. France*, p. 256.

1916. *Lissoceras grasianum* (d'Orbigny) Somogyi: Das Neokom des Gerecsegebirges. *Mitteil. Jahrb. k. ungar. geol. Reichsanst.*, Vol. XXII, Heft. 5, pp. 317, 346.

1922. *Haploceras* (*Lissoceras*) *grasianum* (d'Orbigny) Rodighiero: Il sistema Cretaceo del Veneto Occidentale compreso fra l'Adige e il Piave, etc.. *Pal. Ital.* (Vol. XXV, 1919), p. 82.

1923. *Lissoceras grasi* (d'Orbigny) Fallot and Termier: Ammonites nouvelles des Iles Baléares. *Trab. Mus. Nac. Cienc. Nat., Ser. geol.*, No. 32, p. 79.

1923. *Neolissoceras grasianum* (d'Orbigny) Spath: Monograph of the Ammonoidea of the Gault. *Pal. Soc.*, Vol. for 1921, p. 33.

1925. *Neolissoceras grasianum* (d'Orbigny) Spath: Ammonites and Aptychi. *Mon. Hunter. Mus. Univ. Glasgow.* I, Fossils and Rocks from Somaliland, Pt. 7, p. 113.

1928. *Lissoceras grasi* (d'Orbigny) Fallot: Notes stratigr. sur la Chaine Subbétique. *Bol. R. Soc. Esp. Hist. Nat.*, Vol. XXVIII, p. 284.

1930. *Lissoceras grasi* (d'Orbigny) Roch: Etudes géologiques dans la région méridionale du Maroc occidental. *Service des Mines de la Carte géologique.* Dir. Gén. Trav. Publ. Maroc, p. 305.

1930. *Neolissoceras grasianum* (d'Orbigny) Spath: On the Cephalopoda of the Uitenhage Beds. *Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2, p. 134.

1932. *Haploceras* (*Lissoceras*) *grassianum* (d'Orbigny) Barbu: Catalogul Cephalopodelor fosile din Romania. *Mem. Acad. Rom., sect. stiint*, ser. III, Vol. VIII, Mem. 8, p. 21.

1936. *Neolissoceras grasianum* (d'Orbigny) Besairie: Recherches géologiques à Madagascar. I. La Géologie du Nord-Ouest. *Mém. Acad. Malgache,* fasc. XXI, p. 144, Pl. XIV, figs. 13-14.

1936. *Neolissoceras grasianum* (d'Orbigny) Breistroffer: Revision de la faune hauterivienne du Néron en Chartreuse (Isère). *Bull. Soc. Sci. Dauphiné*, sér. 5, Vol. XIV, p. 539.

There are only two examples of this well-known species, the larger still septate at about 35 mm. diameter. Since the suture-lines are well displayed, I am figuring the two examples (natural size and enlarged ×2), for d'Orbigny's drawing is very diagrammatic. The figures will help the student to appreciate the differences between the suture-lines of *N. salinarium* (Uhlig)[1] and especially *Platylenticeras pseudograsianum* (Uhlig)[2] on the one hand, and of the present form, with its highly frilled elements, on the other. In the Jurassic *Haploceras elimatum* (Oppel) and allies (without the characteristic umbilical and ventro-lateral edges of *Neolissoceras* and less projected apertural lappets) the suture-line is so similar that reference of *N. grasianum* to a different family, *e.g.*, Desmoceratidae[3], cannot be upheld, especially since Oppelids are also known to persist into the Lower Cretaceous[4]. The long range of *Neolissoceras* (from the Infra-Valanginian through the Valanginian to its maximum in the Hauterivian) also makes it probable that it is the direct descendant of the long-lived Upper Jurassic *Haploceras*.

[1] Cephalopoden-Fauna der Teschener-und Grodischter-Schichten. *Denkschr. k. Akad. Wiss.*, Wien., Vol. LXXII, p. 65, Pl. II, fig. 10 (1902).

[2] *Ibid.*, p. 25, Pl. II, fig. 1*b*.

[3] *See* Spath: Ammonoidea of the Gault. *Monogr. Pal. Soc.* (1921), Pt. 1, 1923, p. 33; also Ammonites and Aptychi. *Monogr. Geol. Dept. Hunter. Mus. Glasgow University*, vol. i. Collection of Fossils and Rocks from Somaliland. Pt. VII, p. 113 (1925).

[4] See Spath: Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch). *Pal. Indica*, N. S. vol. IX, no. 2, Pt. VI, p. 824 (footnote). 1933.

Horizon.—Valanginian (Belemnite Beds).
Locality.—687 (2).

Family : *OLCOSTEPHANIDAE*, Spath, 1924.

On the Ammonites of the Speeton Clay and the Sub-divisions of the Neocomian. *Geol. Mag.*, vol. LXI, p. 87.

Sub-family : *OLCOSTEPHANINAE*, Spath, 1931.

Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch). *Pal. Indica*, N. S. vol. IX, no. 2, part IV, p. 546 ; also part VI (1933), p. 694.

To this sub-family were referred the genera *Olcostephanus*, Neumayr, 1875 (often misspelt "*Holcostephanus*"), *Rogersites*, *Subastieria* and *Parastieria*, Spath, 1924 ; and the genus *Saynoceras*, Munier-Chalmas and de Laparent, 1893, is now added, since I agree with Pervinquière[1] in considering it closely allied to *Olcostephanus*. The genus *Valanginites*, Sayn, however, created for the group of *Polyptychites nucleus* (Roemer) v. Koenen[2], seems to me more appropriately left in the sub-family Polyptychitinae. In spite of a recent attempt by Böse[3] to perpetuate the genus *Astieria*, Pavlow, 1897, this must be considered a synonym of *Olcostephanus*, as Lemoine[4] and Kitchin[5] contended.

Two of the Salt Range forms were previously[6] figured as *Olcostephanus* aff. *astierianus* (d'Orbigny) *auctorum*, but the study of the much more abundant new material now available has shown that this widely quoted French species is not itself found in India. Sixteen of the eighteen Salt Range forms here described belong to the restricted genus *Olcostephanus* and although there are no typical *Rogersites* (*e. g. R. modderensis*, Kitchin sp., *R. baini*, Sharpe sp. and *R. kitchini*, Spath[7]), with few and very coarse primary and secondary ribs and prominent umbilical edge, there is one common and widely quoted transitional species between *Rogersites* and *Olcostephanus*. This is *O.* (*Rogersites*) *schenki* (Oppel), but the allied *O.* (*R.*) *atherstoni* occurs in the Salt Range only in doubtful and badly preserved specimens. Since this species has been so frequently misinterpreted, owing to the reduction of the original illustration to $\frac{2}{3}$ linear, I am refiguring Sharpe's holotype in natural size ; and it will be seen that it is, indeed, very close to Baumberger's *O. atherstoni*, discussed below, especially the original of his text-figs. 115-116 (p. 44) though perhaps not the more depressed variety

[1] Pal. Tunisienne. I. Céphalop. des terrains secondaires, p. 144 (1907).

[2] Die Ammonitiden des Norddeutschen Neocom. *Abh. K. Preuss. Geol. Landesanst.* N. F., Heft XXIV, 1902, p. 142, Pl. IV, fig. 6. See Kilian, in Frech : Lethaea geognost. II, 3 ; Pt. 1, fasc. 2, p. 196 (1910). The name *Valanginites* was first mentioned (p. 193) in association with a *nomen nudum* (*V. rebouli*, Sayn, *in litt.*) and then (p. 194) with three published species of which I took the first (*V. perinflatus*, Matheron) to be the genolectotype (*Ann. S. Afr. Mus.*, Vol. XXVIII, 1930, p. 149). But since, on p. 196, Kilian definitely identified the sub-genus *Valanginites* with *Amm. nucleus*, Roemer, and questioned the generic position of *V.* (?) *perinflatus*, my selection is invalid ; and *V. nucleus* (Roemer) must be taken as genotype of *Valanginites*. The genus "*Rotundites*" (Stolley, 1937) has as yet no standing.

[3] Algunas Faunas Cretacicas de Zacatecas, Durango y Guerrero. *Inst. Geol. Mexico*, Bol. 42, p. 69 (1923).

[4] Études géol. dans le Nord de Madagascar. Paris, p. 181 (1906).

[5] The Invertebrate Fauna and Palaeontological Relations of the Uitenhage Series. *Ann. S. Afr. Mus.*, Vol. VII, Pt. 2, p. 185 (1908).

[6] Lower Cretaceous Ammonoidea. *Pal. Indica*, N. S., Vol. XV (The Fossil Fauna of the Samana Range, Pt. V), p. 58, Pl. VIII, figs. 4, 5 (1930).

[7] On the Cephalopoda of the Uitenhage Beds. *Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2, p. 148, Pl. XV, fig. 4 (1930).

of his plate XXXIII, fig. 1. It is hoped that this oft-quoted species will henceforth be more readily identified.

Dr. Folgner had distributed the 97 examples of *Olcostephanus* he studied among 22 species, six of them new; but the names listed in his table of species are not the same as those used in the descriptions. Again, only 15 named forms were sent to me, but they include some of which there is no description, or which had not been listed in the table, which was presumably compiled after the descriptions were written. To trace these inconsistencies in the fragmentary but very voluminous manuscript notes would have meant laborious research, quite out of proportion to the value of the information gained, especially as I had already created myself seven new species for Salt Range examples in the first two collections. Altogether there are now 200 individuals and fragments of *Olcostephanus*, distributed among 18 species; but since the forms of this genus are rather similar and since interpretations of some of the less well-figured species may vary, there is little in the differences in our two lists.

Of more significance might appear to be the fact that I have reduced the number of European species from five (in Folgner) to two; but it may be mentioned that in his description of "*Astieria astieri*", for example (based on a specimen here referred to *Olcostephanus salinarius*, nov.), Folgner did not mention Baumberger's last part (VI) of 1910 (wherein *O. astierianus*, d'Orbigny sp. is refigured and redescribed), and his "*Astieria convoluta*" was based on the resemblance to a Spiti form (here included in *O. fascigerus*) rather than to v. Koenen's North German type. Even if certain species of the European Valanginian, however, occurred in the Salt Range, where the genus *Olcostephanus* is unusually well represented, the majority of the forms here described were local types in Folgner's as in my own opinion.

The various groups into which the genus "*Astieria*" had been divided in Folgner's manuscript are not here believed to represent natural units, except, possibly such small sub-divisions as the group of the evolute *O. madagascariensis* or the group of the untuberculate *O. jeannoti* (d'Orbigny), transitional to *Holcodiscus*. For he included in a group of *O. psilostoma* (Neumayr and Uhlig), among others, such unrelated forms as *Subastieria decipiens*, Spath (=*O.* "*atherstoni*", Pavlow) and *O. hispanica* (Mallada) Nicklès; and a group of *O. atherstoni* (Sharpe) was taken to comprise also all the known species of *Rogersites*, except *R. wilmanae* (Kitchen). The genotype of *Olcostephanus*, namely *O. astierianus* itself, was described as transitional between the group of the finely ribbed *O. sayni* (Kilian) and another, unnamed but very comprehensive group, which was considered to be an Alpine equivalent of the Indo-Pacific group of *O. atherstoni*, and which included most of the remaining forms of *Olcostephanus* known to Folgner, from *O. filosus* (Baumberger) to *O.* "*atherstoni*" (Baumberger) which two species surely belong to the *sayni* and *atherstoni* groups respectively. In the circumstances it is not considered advisable to translate Folgner's lengthy discussion, especially since it would also have to be brought up to date. The species described below also are not referred to "groups", since they are very intimately connected and their separation into divisions based largely on Euro-

pean species would immediately encounter great difficulties. So instead of arranging them in groups, I have attempted to indicate the affinities of the Salt Range species by comparing them to the various forms described in geological literature.

Genus : OLCOSTEPHANUS, Neumayr, 1875.

3. OLCOSTEPHANUS SALINARIUS, sp. nov.

(Plate I, figs. 1-3, 5-8 ; Plate II, figs. 2-5 ; Plate XIX, fig. 4 ; Plate XX, fig. 2.)

1930. *Olcostephanus* aff. *astierianus* (d'Orbigny) *auct.* Spath, *loc. cit.* (*Pal. Indica*, N. S. Vol. XV, Pt. 5), p. 58, Pl. VIII, figs. 4, 5.

Diagnosis.—Subplatygyral, subpachy- to pachygyral, subangustumbilicate. Whorl-section rounded, with greatest thickness at lateral spines (about 20 to 24 per whorl), prominent on rounded umbilical edge and produced in a comma-like, strongly projected rib towards umbilical suture. Four to five secondaries to each tubercle, generally slightly rursiradiate and occasionally interrupted by constrictions. Mouth-border contracted, with lateral lappets. Body-chamber almost a whole whorl. Suture-line very complex, as in other *Olcostephanus*, with long and slender saddles.

Measurements.

Holotype (Plate I, fig. 1) .	69	40	46	29
Paratype (Plate I, fig. 8) . . .	69	40	47	30
var. *crassa*, nov. (Plate I, fig. 3) .	69	39	52	29
var. *obesa*, nov. (Plate II, fig. 5) . .	80	38	50	34
var. *involuta*, nov. (Plate I, fig. 2) . .	58	45	52	22
var. *subfilosa*, nov. (Plate I, fig. 6) .	62	43	50	24

Remarks.—The seventy-five specimens here referred to the present species show considerable variation, yet in view of the well-known variability of all species of *Olcostephanus* it seems inadvisable to split them up into distinct forms. Thus while the paratype has stronger tubercles than the holotype, the original of Plate I, fig. 3 (var. *crassa*) has fewer secondary ribs and is slightly more inflated. The typical inner whorls figured in Plate I, fig. 7 again are much more finely ribbed at first than the young of one of the more inflated varieties, represented in Plate I, fig. 5, but it is sufficient to examine a series of those limonitic immature forms of *Olcostephanus* which occur in such numbers at Barrème and other localities in the Basses Alpes to appreciate their variability in the young. At a larger size the example of which the inner whorls are here figured (Plate I, fig. 5) is very much like the specimen figured in 1930 (fig. 4) and the similar but slightly worn example in the Fleming collection now represented in Plate II, fig. 3. They are both only slightly more inflated than the holotype and connect directly with the example of the var. *obesa* figured in Plate II, fig. 2, while the original of fig. 5 (Spath, 1930) is indistinguishable from the example of the var. *involuta* now figured (Plate I, fig. 2). In the var. *subfilosa* (Plate I, fig. 6) the weakness of the umbilical tubercles is only partly due to wear and it is very close to the var. *involuta*, also having a small umbilicus.

The largest specimen (Morris Coll., No. M3) is still septate at 75 mm. diameter and, instead of contracting, appears to open out at the end and to become greatly inflated. It is possible that this example, the suture-line of which is well exposed (Plate II, fig. 4), is transitional between the present species and a form like *O. victoris*, nov. or *O. sayni* (Kilian) discussed below; but the ornamentation is that of the typical var. *involuta* (Plate I, fig. 2), at a corresponding size. In the case of some smaller or less favourably preserved specimens reference to the present species is suggested merely by the comparatively compressed shape and fine ribbing.

The holotype of *O. salinarius* shows great resemblance to a Castellane (Basses Alpes) example before me (B. M. No. 2454) which at 70 mm. diameter has a whole whorl of body-chamber, also to a smaller Drôme example in the Sharpe Collection. Both are more finely ribbed and probably belong to an unnamed form, transitional between *O. sayni*, Kilian[1] and *O. filosus*, Baumberger[2], but rather more evolute, especially in the young. Less close is probably an example figured as "*Astieria*" *frequens* by Zwierzycki[3]; this seems to be similar but it shows in reality a decline in ornamentation that puts it into quite a different group of *Olcostephanus*. The true *O. frequens* (figs. 4-5), to judge by examples before me from the *Trigonia schwarzi* beds of the type locality (Mikadi), is much more finely ribbed than *O. salinarius*.

In spite of its rather distinctive aspect, the present species is believed to belong to the group of *O. psilostomus*, Neumayr and Uhlig[4] which is widely distributed and which is represented for example from the Valanginian of Bogota, Colombia (B. M. No. 46564) with a typical if slightly compressed example. The young *O. psilostomus typo veneto*, figured by Rodighiero[5] seems to be close to some of the varieties included in the present species, but the same author's large specimen (Plate X, fig. 1) is more coarsely ribbed even than the var. *crassa* of *O. salinarius*. If the reference of the Venetian form to *O. psilostomus* and the comparison with (the crushed) *O. wilmanae*, Kitchin, are at all apt, the section must also be more compressed than in the var. *crassa*. *O. balestrai*, Rodighiero[6], which equally shows resemblance to the species here described, has finer ribbing, with repeated branching, also a wider umbilicus. The somewhat similar *O. polytroptychus*, Uhlig,[7] also differs from *O. salinarius* in the ribbing; it may be a more closely related form than the compressed shape (apparently only due to deformation in the rock) and the subsequent reference by Uhlig[8] of his species to the genus *Spiticeras* suggest.

[1] See in Baumberger: Fauna der unteren Kreide im westschweizerischen Jura; Part VI; *Abh. Schweiz. pal. Ges.*, Vol. XXXVI, p. 7, Pl. XXXII, figs. 2-3 (1910).

[2] See in Bayle: Explic. Carte géol. France. Vol. IV; Atlas, Pt. 1, Pl. 55, fig. 2 only(1878).

[3] Die Cephalopoden Fauna der Tandaguru Schichten in Deutsch-Ostafrika. *Archiv f. Biontol.*, Vol. III, Heft 4, Wiss. Ergeb. Tendaguru Exped. 1909-1912, Pt. 3, p. 51, Pl. VI, figs. 14-15 (1914).

[4] Ammonitiden aus den Hilsbildungen Norddeutschlands. *Palaeontogr.* Vol. XXVII, p. 149, Pl. XXXII, fig. 2 (1881).

[5] *Pal. Italica*, Vol. XXV p. 88, Pl. IX (II), fig. 11 (1922).

[6] *Ibid.*, p. 84, Pl. IX (II), fig. 10.

[7] *Jahrb. k. k. geol. Reichsanstalt*, Vol. XXXVII, p. 106, Pl. V, fig. 4 (1887).

[8] Fauna of the Spiti Shales. *Pal. Indica*, Ser. XV, Vol. IV, fasc. 1, 1903, p. 87. If Djanélidzé (in Kilian: Contributions àl'Etude des Céphalopodes paléocrétacés du S. E. de la France. Les *Spiticeras* du S. E. de la France. *Mém. Expl. Carte Géol. dét. France*, 1922, p. 162, Pl. XVIII, figs. 4*a*, *b*) has correctly interpreted Uhlig's species, it is quite distinct from *O. salinarius*.

Folgner distributed some forty examples here included in *O. salinarius* among seven or more species, three of them new, but they fall easily within the varieties here recognised. One inflated example was labelled *Astieria astieri* and described as *A. sayni*, Kilian, var. *globulosa*, Wegner; but as I had myself first recorded the Salt Range form as *Olcostephanus* aff. *astierianus* (d'Orbigny) auct., there is little in the difference of opinion. Another similar example of the var. *obesa* was given a new MS. name (on the label) but was not described, while a specimen comparable to that figured in Plate II, fig. 5 was referred to *Astieria* sp. aff. *uitenhagensis* (Kitchin). Examples of the var. *crassa* and the var. *involuta* also had been given separate specific names and one specimen of the typical *O. salinarius* was labelled *Astieria* cf. *convoluta* (v. Koenen). What is perhaps of more interest is that while the majority of the examples were correctly referred to the group of *Astieria psilostoma* some of the others were relegated to quite different groups. Since all forms of *Olcostephanus* are essentially similar, it is of course impossible sharply to define these groups; but it is interesting to note that the Salt Range material, however poorly preserved, is so rich in specimens that can with ease be referred to a single species and its varieties.

Horizon.—Valanginian (Belemnite Beds).

Localities.—678 (1 ?); 682 (1); 685 (6); 687 (10, and 7 doubtful examples); 687*a* (2); 692 (1); 699 (2); 50 (10?); Chichali Hills (3); Chichali Nala, north limb (1); Kalabag (1); Chichali Pass (41).

4. Olcostephanus, sp. ind. cf. drumensis (Sayn MS.) Kilian.

(Plate VII, figs. 7*a*, *b*.)

1910. *Holcostephanus* (*Astieria*) *drumensis*, Sayn; Kilian. *loc. cit.* (Lethaea geognostica, fasc. 2), Pl. III, figs. 2*a*, *b* (p. 177).

Half an ammonite, completely septate, and with the following dimensions:—

Diameter	92 mm.
Height of last whorl	43%
Thickness of last whorl	50%
Umbilicus	27%

agrees with typical large French specimens of the group of *O. astierianus* (d'Orbigny)-*O. filosus* (Baumberger), such as the example I[1] referred to on a previous occasion. Side-view and ornamentation suggest comparison with *O. sayni* (Kilian),[2] a member of that group, but the whorl-section is different. *O. filosus*, on the other hand, with similar shape,[3] is still more finely ribbed and, to judge by a young example in my collection from the Biancone of Rozzo (Sette Communi), lacks the comparatively coarse early stage which characterises many Salt Range forms, even *O. salinarius* (compare Plate I, fig. 5).

In the circumstances, identification with the incompletely known form above cited is impossible. There are fewer secondaries in the French form to the

[1] *Ann. S. Afr. Mus.*, Vol. XXVIII, p. 143 (1930).
[2] See Baumberger, *loc. cit.*, p. 7, Pl. XXXII, figs. 2 & 3 (1910).
[3] See Baumberger, *loc. cit.*, p. 8, text-fig. 149 B (1910).

same number of umbilical tubercles (twelve per half whorl), but it is here assumed that this is merely a matter of size. On the other hand, the venter of the Salt Range form is less flattened than that of *O. drumensis* or of the similar but later and less finely ribbed *O. guebhardi*, Kilian.[1] It will be seen that although the Indian form may not be identical with *O. drumensis* and apparently not the Moroccan examples recorded by Roch,[2] it is still less closely comparable to other European species and it is more finely ribbed than any of the Salt Range forms described below of similar whorl-shape.

A second example, received after the completion of the manuscript seems to differ in proportions (98 —·46 —·52 —·25), but the differences may be due merely to the fact that both specimens are imperfectly preserved. The ornamentation is of the same type, so far as can be seen.

Horizon.—Neocomian (Belemnite Beds). The species is Valanginian and it seems very doubtful whether it continues into the Hauterivian, as claimed by Kilian and Reboul.[3]

Localities.—687 (1) and Baroch Gorge, No. K 40/158*b* (1).

5. Olcostephanus globosus, sp. nov.

(Plate V, figs. 3*a*, *b*.)

Diagnosis.—Platygyral, extremipachygyral, subangustumbilicate. Whorl-section greatly depressed, with broadly arched venter and very high and steep umbilical wall, but rounded edge. About 24 tubercles, corresponding to about five or more secondaries each, slightly reclined on side but straight across venter. Continuations of elongated tubercles to the umbilical suture very feeble and only slightly reclined. No constrictions visible. Suture-line very complex, with very slender saddles, similar to that of *Rogersites sphaeroidalis*, Spath.[4]

Measurements.

Diameter	114 mm.
Height of last whorl	42%
Thickness of last whorl	90%
Umbilicus	25%

Remarks.—This form is much more finely ribbed than *Rogersites sphaeroidalis*, but differs chiefly in the configuration of the umbilical wall, which in the South African species is not only vertical or even over-hanging, but strongly ribbed, so that the sharp and crenulate umbilical edge at larger diameters is a very conspicuous feature. *R. atherstoni* (Sharpe)[5] which is also more coarsely ribbed and far less inflated than *O. globosus*, similarly has a strongly costate

[1] Sur quelques fossiles remarquables de l'Hauterivien de la region d'Escragnolles. *Bull. Soc. géol. France* (4), Vol. II, p. 866, Pl. LVII, figs. 2*a*, *b* (1902).

[2] Etudes géologiques dans la region méridionale du Maroc occidental. *Service des Mines et de la Carte géologique.* Dir. Gén. Trav. Publ. Maroc., p. 314 (1930).

[3] *Mém. Explic. Carte géol. France*, pp. 256, 263 (1915).

[4] *Ann. S. Afr. Mus.*, Vol. XXVIII, p. 144, Pl. XIII, fig. 5 (1930).

[5] Description of Fossils from the Secondary Rocks of Sunday River and Zwartkop River. *Trans. Geol. Soc. London*, Ser. 2, Vol. VII, p. 196, Pl. XXIII, figs. 1*a*, *b* (1856).

and vertical umbilical wall and is far less close to the present species than it is to *R. sphaeroidalis*.

O. stephanophorus (Matheron),[1] with far more rapid increase in whorl-thickness, is probably closer to the form described below as *O.* cf. *perinflatus* (Matheron) than to the present species, while *O.* sp. ind. (Plate III, fig. 5) has ribs which are not only finer and sharper than those of *O. globosus*, but which are distinctly flexuous across the venter. "*Holcostephanus*" (*Astieria*) cf. *schenki* (Oppel) Uhlig,[2] which is here attached to the form described below as *O. sublaevis*, nov., increases less rapidly in thickness and has a much less prominent umbilical edge. There are a number of examples, however, which show merely finer ribbing than Uhlig's form, and which may be intermediate between the present species and *O. sublaevis*.

Horizon.—Neocomian (Belemnite Beds).

Localities.—687(1); 687A(3 ?).

6. Olcostephanus glaucus, sp. nov.

(Plate VI, figs. 7*a*, *b*; 8.)

Diagnosis.—Subplatygyral, pachygyral, subangustumbilicate. Whorl-section reniform, with evenly rounded periphery and high and steep umbilical wall, but rounded edge. About 20-24 umbilical tubercles, giving rise to, first only about three, later more, secondaries. Occasional constrictions, projected and then recurved, like the ribbing. Umbilical tubercles produced on umbilical wall with strong forward sweep. Suture-line very complex, with slender saddles. Second lateral saddle enclosing umbilical tubercle and followed by two more saddles on umbilical wall.

Measurements.

	Holotype (Plate VI, fig. 8).	Paratype (Plate VI, fig. 7).
Diameter	114	80 mm.
Height of last whorl	47	42%
Thickness of last whorl	54	58%
Umbilicus	23	27%

Remarks.—Both the figured specimens and all the additional examples available are entirely septate, but there is no indication that the species became more inflated with age, like large *Rogersites*. The young greatly resembles the malformed *O.* (*R.* ?) aff. *schenki* (Oppel) figured in Plate II, fig. 8, but, judging by a larger Madagascan example of that species (B. M. no. C. 38023), it retains the coarse early stage and the inflation to a much larger diameter than *O. glaucus*, and is transitional to *Rogersites*. The present form, on the other hand, with its fine secondary ribbing on the later whorls, its rounded umbilical edge and weakened tubercles, clearly is more nearly related to the species of *Olcostephanus* (Plate V, figs. 4*a*, *b*; 5*a*, *b*) that occur with *Rogersites* in Madagascar.

[1] Recherches paléontologiques dans le midi de la France. II; Pl. B-20, figs. 4*a-c* (1878).

[2] Fauna of the Spiti Shales. Fasc. 2. *Pal. Indica.* Ser. XV, Vol. IV, Pl. XLII, figs. 1*a-c* (1910).

While the form described below as *O. sublaevis* is more inflated, more evolute and more strongly tuberculate, *O. fascigerus*, nov., is more distinctly coronate than *O. glaucus*, with not only greater inflation but a higher and steeper umbilical wall and different costation. *O. sharpei*, Karakasch[1] (=*Holcostephanus atherstoni*, Karakasch[2] *non* Sharpe) from the Valanginian of Biassala (Crimea) is similar to *O. glaucus* in side-view, but it has a wider umbilicus. Two small fragments, apparently of the present form, had indeed been referred by Folgner to Karakasch's species. The somewhat similar *O. guebhardi*, Kilian,[3] already cited, has a broader periphery and more prominent umbilical spines, if the whorl-section given by Baumberger[4] agrees with that of Kilian's type; the latter also retains slightly coarser ribbing to a larger diameter than does *O. glaucus*. An example labelled by Folgner "*Astieria guebhardi* (=*A. sharpei*, Karakasch)", however, is more evolute than *O. glaucus* and not only badly preserved but slightly malformed. Two more fragments, labelled by Folgner "Group of *A. atherstoni*, approaching *A. pachycyclus*," may also provisionally be referred to *O. glaucus*.

O. (*Rogersites*) *curvicostatus* (Besairie)[5] resembles the species here described, also *O. fascigerus*, but it is distinguished from both the Salt Range forms by its rib-curve, although the paratype of *O. glaucus* seems to be somewhat transitional.

Horizon.—Neocomian (Belemnite Beds).

Localities.—685 (2); 687 (2), and two doubtful fragments; 687A (1); Chichali Pass (5).

7. Olcostephanus fascigerus, sp. nov.

(Plate IV, figs. 1-3.)

Diagnosis.—Subplatygyral, pachygyral, subangustumbilicate. Whorl-section rounded, with greatest thickness at prominent umbilical edge and high and steep wall. Tubercles prominent, with greatly projected prolongations to umbilical suture and bundles of fine secondaries, 3 to 4 at first, later 5 or 6 to each tubercle. Occasional constrictions, preceded by a strengthened rib, more oblique than ordinary costation. Suture-line highly complex, similar to that of the other species here described.

Measurements.

	Holotype (Plate IV, fig. 1).	Paratype (Plate IV, fig. 2).
Diameter	110	78 mm.
Height of last whorl	42	42%
Thickness of last whorl	60	61%
Umbilicus	25	25%

[1] Le Crétacé inférieur de la Crimée et sa faune. *Trav. Soc. Imp. Naturalistes, St. Pétersb.*, Vol. XXXII, livr. 5, p. 123 (1907).

[2] Note sur le Crétacé inférieur de Biassala (Crimée). *Trav. Lab. géol. Grenoble*, Vol. VI, p. 103, Pl. I, fig. 3 (1902).

[3] For interpretation of this species see Roch, *loc. cit.* (Maroc, 1930), p. 312.

[4] *Abh. Schweiz. pal. Ges.*, Vol. XXXV, pt. 5, p. 12, text-fig. 122*a* (1908).

[5] *Mém. Acad. Malgache*, fasc. XXI, p. 141, Pl. XII, figs. 7, 10; Pl. XIII, fig. 18 (1936).

Remarks.—It is possible that this form includes the Himalayan (Lochambelkichak) example figured by Uhlig[1] as *Holcostephanus* (*Astieria*) cf. *convoluta*, v. Koenen, but owing to difference in size comparison is not easy and the outline whorl-section may have been restored by the artist. On the other hand, judging by a German (Stadthagen) example (B. M. no. C. 14791) of *O. convolutus* (v. Koenen) before me, that species is still more depressed and more inflated at the same diameter than *O. fascigerus* and, while having the rib-bundles characteristic of the latter, does not appreciably change these during growth. The comparatively slight thickness of the whorl in the Himalayan form (only 49% of the diameter) and the wider umbilicus (30%) I take to be merely due to its much larger size (148 mm.).

While the holotype of the present species includes half a whorl of body-chamber, the paratype is entirely septate, as is a third specimen, figured in Plate IV, fig. 3, but a fourth example, slightly more inflated and therefore transitional to *O. sublaevis*, described below, also retains half a whorl of body-chamber, at about the same size as the holotype. This example shows that the holotype and paratype, though apparently dissimilar, yet belong to the same species. Whether this is as close to *O. uitenhagensis*, Kitchin,[2] as the bundling of the ribs suggests, seems doubtful; for the South African form is not only laterally flattened, but has the tubercles nearer the umbilicus than *O. fascigerus*. I previously[3] referred *O. uitenhagensis* to *Rogersites*, but like *R. atherstoni*, *R. sphaeroidalis* and the many passage-forms between these species, *O. uitenhagensis* is one of the transitions from *Rogersites* to *Olcostephanus*.

O. rabei (Besairie)[4] greatly resembles the present species. The Madagascan ammonite listed on p. 138 as *O. fascigerus*, indeed, is probably a passage-form between the two species, for it has coarser ribbing, a less wide venter and less prominent tubercles than the holotype of the form here described.

In the Wynne collection examined by Folgner there are two examples, not well preserved, that had been labelled *Astieria* sp. nov. aff. *victoris* and *A.* sp. (group of *A. schenki*) respectively. Unlike the "*A. schenki*" figured in Plate XIX, fig. 2 and discussed under *O. sublaevis*, the second example is almost certainly referable to *O. fascigerus*, but the first, while clearly differing from the compressed *O. victoris*, may be a transition between the two species. Another specimen, labelled by Folgner "*Astieria atherstoni*" has the ribbing of *O. victoris* but the inflation of *O. fascigerus* and likewise represents a passage-form. Three more doubtful fragments, labelled *Astieria scissa*, Baumberger, and *A.* sp. (group of *A. scissa*) can only be provisionally included here, but they show no trace of branching of the ribs near the periphery which is characteristic of Baumberger's species and the related *O. filosus*.

A different species altogether may be represented by a body-chamber fragment which had been referred by Folgner to the "group of *Astieria atherstoni*". The ribbing is comparable to that of the present species but only on the penultimate

[1] *Pal. Ind.*, Ser. XV, Vol. IV, fasc. 2, Pl. LXXVIII, fig. 1; fasc. 3, p. 394 (1910).
[2] *Ann. S. Afr. Mus.*, Vol. VII, p. 206, Pl. XI (1908).
[3] *Ann. S. Afr. Mus.*, Vol. XXVIII, p. 150 (1930).
[4] *Mém. Acad. Malgache*, fasc. XXI, p. 141, Pl. XII, figs. 8, 9; text-fig. 9, p. 139, No. 8 (1936).

whorl, and it has disappeared almost completely on the body-chamber. This comparative smoothness is reminiscent of some examples of *O. salinarius*, var. *obesa*, nov. which, however, is generally much smaller and lacks the high umbilical wall of the fragment here discussed. Pending the discovery of more complete specimens, the fragment may be considered to represent a transition between *O. salinarius* and *O. fascigerus*.

Horizon.—Neocomian (Belemnite Beds).

Localities.—685 (1); 687A (1); 50 (5); Makerwal Colliery, Miranwal District, Punjab (3); Chichali Nala, north limb (1); Chichali Pass (7).

8. Olcostephanus victoris (Folgner MS.) sp. nov.

(Plate XIX, figs. 7*a*, *b*.)

Diagnosis.—Subplatygyral, pachygyral, subangustumbilicate. Whorl-section rounded, depressed, with umbilical shoulder rather marked and greatest thickness a little above the tubercles where these are worn (the measurements below are without the tubercles). Umbilical wall high and perpendicular, but with rounded edge. Venter evenly arched. Primary ribs very oblique, comma-shaped, ending in a radially elongated, sharp spine on the umbilical edge. About seven secondary ribs to each tubercle, three or four in a bundle and the remainder intercalated. Ribbing projected and flexuous on side but straight across venter. Occasional oblique constrictions. Suture-line complex, as in other large forms of *Olcostephanus*.

Measurements.

	Holotype (Pl. XIX, fig. 7*a*).	Paratype (Pl. XIX, fig. 7*b*).
Diameter	112	105 mm.
Height of last whorl	43	43%
Thickness of last whorl	54	53%
Umbilicus	26	26%

Remarks.—Folgner did not describe this species but the two specimens here figured were labelled "*Astieria victoris*" and the labels bore the remark "verwandt mit *A. filosa*, Baumberger". There is indeed great resemblance between the two species and if I do not now unite them it is because the Salt Range examples do not show branching of the ribs which is as common in typical French specimens of *O. filosa* before me (*e.g.*, B. M. nos. 73427, C. 31110) as in *O. scissus* (Baumberger) and because the constrictions are not prominent in the latter form. *O.* sp. ind. cf. *drumensis* (Sayn MS.) Kilian, described above, is also very close to *O. victoris* and might, perhaps, be taken to be merely a worn example of the present species (which was not represented in the first two collections). They are now kept apart chiefly because the tubercles are more rounded and blunter in *O.* sp. ind. cf. *drumensis* and the inner whorls are probably less finely ribbed. I am figuring in Plate XX, figs. 2*a*, *b* the inner whorls of a fragmentary ammonite which had been labelled by Folgner "Gruppe der *A. victoris*" and it clearly shows the *filosus* characters already at a diameter of 21 mm. In a fourth example

labelled "*A.* sp. ex aff. *victoris*" the earlier whorls, it is true, are not different from those of *O.* sp. ind. cf. *drumensis*, but, at a diameter of 60 mm. and over, this fourth specimen shows the typical, bundled ornamentation of *O. victoris*, whereas *O.* sp. ind. cf. *drumensis* has almost smooth inner whorl-sides and no rib-bundles still at a much later stage.

Of the other Salt Range species here described *O. fascigerus*, nov. is much more inflated, but there are transitions, as already mentioned. *O. glaucus* has much coarser early whorls. *O. salinarius*, however, by way of forms like that figured in Plate II, fig. 4, is connected with the present species. Since the holotype of *O. victoris* includes only a small portion of the body-chamber while the paratype is entirely septate, it is probably a much larger species than the typical *O. salinarius*, which, moreover, is compressed and has a shallow umbilicus.

Among the forms of *Olcostephanus*, all of Hauterivian aspect, figured by Somogyi[1], *O. schafarziki* most resembles the present species, but the resemblance is superficial. For the Salt Range form not only has no branching secondary ribs, but these are scarcely visible in the umbilicus.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Chichali Pass (4).

9. Olcostephanus sublaevis, sp. nov.

(Plate III, figs. 1-3, Plate XIX, fig. 2.)

Diagnosis.—Subplatygyral, pachygyral, subangustumbilicate. Whorl-section depressed, reniform, with high and convex umbilical slope and well-rounded edge. About 12 umbilical bullæ to the half-whorl, well produced on umbilical slope and each giving rise to 5 or 6 secondaries on adult whorls, but only about 3 on inner. Strongly marked constrictions, with accompanying ridges, cutting obliquely across costation. Suture-line very complex, more so than that of the similar *O.* (*Rogersites*) *schenki* (Oppel), but simple in young.

Measurements.

	Holotype (Plate III, fig. 1).		Plate III, fig. 2.
Diameter	55	100	95 mm.
Height of last whorl		45	43%
Thickness of last whorl	62	67	70%
Umbilicus		24	24%

Remarks.—The three larger examples available are all septate and fragmentary. The holotype is worn on the side not figured and the example represented in Plate III, fig. 2 is slightly deformed (obliquely) by pressure, so that its increase in thickness may not be as rapid as it appears. In any case, the holotype and the third (unfigured) large example show great resemblance to

[1] Das Neokom des Gerecse Gebirges. *Mitteil. Jahrb. k. ungar. geol. Reichsanst.*, Vol. XXII, Heft 5, p. 325, Pl. XIII, fig. 3 (1916).

Uhlig's[1] *Holcostephanus* cf. *schenki*, which, if not identical with the present form, must be a very close ally. But as it is considerably smaller than the two specimens of *O. sublaevis* here figured, it is impossible to say whether the apparent difference in the rate of increase is important. The true *O.* (*Rogersites* ?) *schenki* (Oppel)[2] is more coarsely ribbed and has a more prominent umbilical edge than even the transitional small example figured in Plate II, figs. 8*a*, *b*. This latter, like *O.* (*R.* ?) *schenki*, is seen to show about 20 peripheral ribs (fig. 8*b*) to 24 in the holotype for the same distance (left-hand side of fig. 1, Plate III). But the rounding of the umbilical edge also is a distinctive feature of the present form and is noticeable already on the inner whorls of Uhlig's larger *O.* cf. *schenki*; and although these differences may not be of any importance, they are at least as conspicuous as differences among the many other species of *Olcostephanus*. The young example figured in Plate III, fig. 6, with a very deep crater-like umbilicus, is perhaps still more distinctly transitional to the true *O.* (*R.* ?) *schenki* than the inner whorls represented in Plate III, fig. 3. The suture-line of its smooth inner whorls is simpler than that of a typical French form figured on the same plate (fig. 7).

O. curacoensis (Weaver)[3] is probably close to the present species, at least the smaller paratype (fig. 326), while the larger holotype, with only slightly different dimensions, is too poorly preserved at a comparable stage to be accurately identified. If the figure of the paratype of this form (described as of Valanginian age in the text and as Hauterivian on the plate) can be relied on, *O. curacoensis* differs from the species here described merely in its more pronounced umbilical edge and the vertical wall. But it seems inadvisable to attach the Indian form to an Argentine species and thus suggest a possibly entirely wrong relationship.

O. (*Rogersites*) *spathi* (Besairie)[4] greatly resembles the form here described, but has more numerous primary ribs in the adult and finer ribbing in the young. The whorl-section represented in Plate III, fig. 3*b* also is more like that of Besairie's *O.* (*R.*) *douvillei*[5] than that of *O.* (*R.*) *spathi*.

In the Wynne collection, received after the above was written, the present species is represented by eleven examples of which that figured in Plate XIX, fig. 2 is the most favourably preserved. Its ribbing seems unusually sharp, but this is probably only because the holotype of *O. sublaevis*, like Uhlig's Himalayan form, does not retain the test. The proportions are similar (67 —·42 —·70 —·27) and there is good agreement with the specimen figured in Plate III, fig. 3. But the original of Plate XIX, fig. 2, which had been labelled by Folgner *Astieria schenki*, is slightly crushed at the end, so that its umbilical edges appear very prominent and it seems to grow into a much more cadicone shell than the holotype. It is broken off apparently at the last septum.

[1] *Pal. Ind.*, Ser. XV, Vol. IV, fasc. I, p. 130 (1903); fasc. 2, Pl. XLII, figs. 1*a-c* (1910).

[2] See in Uhlig, *loc. cit.*, fasc. 1, p. 130, Pl. XVIII, figs. 2*a-e* (1903).

[3] Palæontology of the Jurassic and Cretaceous of West Central Argentina. *Mem. Univ. Washington*, Vol. I, p. 427, Pl. 49, figs. 326-7 (1931).

[4] *Mém. Acad. Malgache*, fasc. XXI, p. 140, Pl. XII, figs. 1-2; test-fig. 9, p. 139, figs. 6 and 10 (1936).

[5] *Ibid.*, fig. 2.

Of the other examples, mostly doubtful, the best is labelled *Astieria* sp. nov. (group of *A. atherstoni*), but Sharpe's species is much more coarsely ribbed and has a far less broad periphery than *O. sublaevis*. Another was identified as *A.* sp. nov. cf. *scissa*, Baumberger, but the bifurcation of some of the ribs is apparently due to imperfect preparation or accidental scraping. This form could be a transition to *O.* sp. ind. (Plate III, fig. 5), with a similar rib-curve. The remainder were again doubtfully referred to *A. schenki* and *A.* sp. ind., except one which was labelled *Astieria* cf. *convoluta*. But this has a whorl-thickness of only 56 per cent. (at about 90 mm. diameter) and thus forms a distinct transition to *O. glaucus*, if it does not actually belong to that species itself.

Horizon.—Neocomian (Belemnite Beds).

Localities.—673 (1); 682 (1); 685 (2); 687 (5, including doubtful fragments); 687A (1); ¾ mile E. of Khairabad, Salt Range, K 35/781 (1). Chichali Pass (11).

10. Olcostephanus pachycyclus (Folgner MS.) nov.

(Plate XIX, fig. 5; Plate XX, figs. 1*a*, *b*.)

Diagnosis.—Subplatygyral, perpachygyral, subangustumbilicate. Whorl-section depressed, reniform, with widely arched periphery and rounded umbilical edge, but perpendicular umbilical wall. About 23 primary ribs, radial or nearly so, and terminating in a conspicuous tubercle at umbilical edge. About three secondary ribs to each tubercle, nearly radial and perfectly straight across venter. Oblique and deep constrictions with prominent rim behind, truncating as many as seven ribs. Suture-line complex, with characteristic, straight elements and first lateral lobe as deep as the external lobe.

Measurements.

Diameter	57	70 mm.
Height of last whorl	42	38%
Thickness of last whorl	72	73%
Umbilicus	25	27%

Remarks.—The holotype is only a septate nucleus of possibly a very large species; and the second example (Plate XIX, fig. 5), provisionally referred by Folgner to the same *pachycyclus* group, is still smaller. Yet the form is different from those represented in the first two collections and must be described separately. Folgner thought that this species was to a certain extent the counterpart (presumably Indo-Pacific) of *Amm. perinflatus*, Matheron, of the Mediterranean province, with similar dimensions and radial rib-bundles. But a comparison of the illustrations will show that *O. perinflatus* has a different whorl-section, while the form here described as *O.* cf. *perinflatus* (Plate VI, fig. 6) is much more closely ribbed. *O.* sp. ind. (Plate III, fig. 5) has a more rounded periphery and a different rib-curve; but the specimen figured in Plate III, fig. 2 and provisionally attached to *O. sublaevis* might be held to belong to the same species as the holotype of *O. pachycyclus*. Enough, however, is visible

of its inner whorls to show that they were more slender, like those of *O. sublaevis*, so that *O. pachycyclus* is a distinct species.

Folgner compared the present form chiefly to species that group themselves round *O.* (*Rogersites*) *atherstoni* (Sharpe), above discussed, but thought it easily separable on account of its dimensions. He considered that similar forms occurred apparently in the Uitenhage formation and referred to an unspecified figure in Hatch and Corstorphine.[1] But since he expressly mentioned that Kitchin[2] did not discuss this figure he cannot have referred to fig. 65, p. 243 (fig. 73, p. 295 in the 1909 edition) which was mentioned by Kitchin on pp. 194 and 206; and the other forms figured are unrelated species. *O.* (*R.*) *atherstoni* itself has far more slender inner whorls than *O. pachycyclus*.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Chichali Pass (2).

11. Olcostephanus, sp. ind.

(Plate III, fig. 5.)

The most distinctive feature of the extremely inflated form of *Olcostephanus* here figured, is the sinus in the peripheral ribbing, which is distinctly biconvex, being directed forwards after leaving the lateral tubercles, but slightly reflexed in the siphonal line. The umbilical wall is hidden, but enough of the tubercles is visible to show that there were six to about thirty-one peripheral ribs. The approximate measurements are :—

Diameter	95 mm.
Whorl-thickness	73 mm. or 77%

Whorl-height and width of umbilicus cannot be determined, but the section must have been as depressed as that of the form described below as *O.* cf. *perinflatus* (Matheron), while the umbilicus was probably not wider than that of the French species. The illustration shows the body-chamber only, but a portion of the crushed earlier whorl is visible on the opposite side and shows particularly prominent spines such as are found in *Subastieria*, e.g., *S. dacquei* (Krenkel)[3], or in *O. klaatschi*, Wegner.[4]

O. (*Rogersites*) *atherstoni* (Sharpe), already referred to, and especially *R. sphaeroidalis*, Spath,[5] are less finely ribbed than the present form and there is no indication that this had the coronate umbilical rim and vertical wall of typical *Rogersites*. Of other globose species of *Olcostephanus*, only *O. stephanophorus* (Matheron), already referred to, can be compared to the present form, but it is here believed to be closer to *O.* cf. *perinflatus*, described below, with finer ribbing; for the inner whorls of the form here discussed were probably far more coarsely ribbed than *O. stephanophorus*, judging by the whorl-portion shown on the side not figured.

[1] Geology of South Africa. London, 1905; 2nd ed. (1909).

[2] *Ann. S. Afr. Mus.*, Vol. VII, Pt. 2, No. 3 (1907).

[3] Die untere Kreide von Deutsch-Ostafrika. *Beitr. Pal. Geol. Österr.-Ung.*, etc., Vol. XXIII, p. 225, Pl. XXII, fig. 6 (1910).

[4] Übersicht der *Astieria* Formen. *N. Jahrb. f. Min.*, etc. (I), p. 89, Pl. XVI, figs. 1-2 (1909).

[5] *Ann. S. Afr. Mus.*, Vol. XXVIII, p. 144, Pl. XIII, fig. 5 (1930).

The wide periphery, combined with prominent spines, suggests comparison of the form here described with *O. wilfridi*, Karakasch.[1] The holotype of that species, however, is small; and since the inner whorls of the present form are not exposed, inside the line of tubercles, neither the primary ribs nor the width of the umbilicus can be observed.

Horizon.—Neocomian (Belemnite Beds).

Locality.—685 (1).

12. Olcostephanus cf. perinflatus (Matheron).

(Plate VI, fig. 6.)

Half an ammonite, belonging to a very globose species of *Olcostephanus*, and slightly larger than the holotype of *O. perinflatus* (Matheron),[2] is rather poorly preserved so that only the whorl-shape, as shown in a natural cross-section, is illustrated (Plate VI, fig. 6). The most obvious differences between this fragment and Matheron's species are a slightly wider umbilicus and parallel, not converging sides of the body-chamber, also finer ribbing across the periphery. This makes it probable that the present form is also close to *O. stephanophorus* (Matheron),[3] but on account of difference in size, exact comparison is impossible and, in any case, the whorl-section is different. Neither aperture nor suture-line is preserved. About half a whorl from the end the specimen shows the following dimensions:—

Diameter	75 mm.
Height of last whorl	40%
Thickness of last whorl	84%
Umbilicus	27%

These measurements differ from those of Matheron's figure merely in the greater thickness, due to absence of contraction, but on the last half-whorl of the present form the width of the umbilicus had increased to about 36 per cent. There are about twelve tubercles to the half-whorl (of body-chamber), but the number of these depends partly upon the size and it may be variable; for Roch[4] recorded a Moroccan example of *O. perinflatus* in which there were only sixteen tubercles, as against twenty in Matheron's type.

Astieria dolioliformis, Roch,[5] which shows greatly depressed (but very coarsely ribbed) whorls, apparently is a *Valanginites*. I previously referred to this genus both *O. perinflatus* and *O. stephanophorus* but the genus must be restricted to the group of *V. nucleus* (Roemer) and includes, beside the genotype, only *V. utriculus* (Matheron), and such doubtful small forms as *V. simplex* (d'Orbigny)

[1] *Trav. Lab. géol. Grenoble*, Vol. VI, p. 106, Pl. I, figs. 1-2 (1902).

[2] *Reck. Pal. Midi de la France*, Pl. B20, figs. 7*a*, *b* (1878).

[3] *Ibid.*, figs. 4*a*, *b*. Kilian (Description géologique de la Montagne de Lure, Basses-Alpes, 1889, p. 202) thought that this species was only the young of *O. perinflatus*.

[4] *Loc. cit.* (Maroc), p. 313 (1930).

[5] *Ibid.*, p. 314, Pl. XVI, figs. 4*a*, *b*.

and, perhaps, *V. bachelardi* (Sayn)[1]. Some undescribed Columbian Polyptychitids before me, distantly resembling *Astieria laticosta*, Gerth,[2] suggest that the resemblance between the true *Valanginites* and the inflated forms of *Olcostephanus*, like the species here described, is quite superficial; but there are also morphological transitions between *Polyptychites* and *Rogersites*.

Horizon.—Neocomian (Belemnite Beds).

Locality.—685 (1).

13. Olcostephanus geei, sp. nov.

(Plate VII, figs. 5-6.)

Diagnosis.—Subplatygyral, pachygyral, subangustumbilicate. Whorl-section rounded, with greatest thickness at umbilical rim and moderately high, convex, umbilical slope. Tubercles very faint (on cast), corresponding to, at first, only two or three, later more, secondaries. Occasional irregular constrictions. Suture-line complex, with long and slender external and first lateral saddles, and bifid second lateral saddle on rounded umbilical rim.

Measurements.

	Holotype (Plate VII, fig. 5).	Plate VII, fig. 6.
Diameter	65	87 mm.
Height of last whorl	46	43 %
Thickness of last whorl	60	56 %
Umbilicus	20	20 (?) %

Remarks.—The holotype is entirely septate and its innermost whorls are not exposed, but the example figured in Plate VII, fig. 6 shows the earliest volutions (figured separately in figs. 6*b*, *c*); and it can be seen that they are perfectly smooth to a diameter of about 12 mm., that is, to a much later stage than in the Valanginian *O. chaignoni*, *O.* (?) *bachelardi*, Sayn and their associates or in the Hauterivian *O. astierianus* and allies. Ribs then appear, at first very feeble, but at about 15-18 mm. they become distinct, though they are still low and very blunt. To a diameter of about 45 mm. the ribbing is coarser than that of any other Salt Range form of *Olcostephanus*, except *O.* (*Rogersites*) *schenki* (Oppel), there being only 25 ribs to the half-whorl; but at larger diameters the ribs again become closer and blunter.

The tendency to reduce the tuberculation and produce almost smooth inner whorl-sides, giving the present species its distinctive appearance, is reminiscent of those late and often small forms of *Olcostephanus* in which the umbilical spines are lost or reduced, but the inner whorls show the present species to

[1] Note sur quelques Ammonites nouvelles ou peu connues du Néocomien inférieur. *Bull. Soc. géol. France* (3), Vol. XVII, 1889, p. 679, Pl. XVII, figs. 1*a*, *b*. According to Baumberger (Beschreibung zweier Valangien Ammoniten, nebst Bemerkungen über die Fauna des Gemsmättli-Horizontes von Sulzi im Justital. *Eclogae geol. helvet.*, Vol. XVIII, No. 2, 1923, p. 310) this is identical with *Pachyceras psaephoides*, Mayer-Eymar (Systematisches Verzeichnis der Kreide- und Tertiär-Versteinerungen der Umgegend von Thun. *Beitr. z. geol. Karte d. Schweiz.* Lief. 24, pt. II, 1887, p. 9, Pl. I, fig. 13) which thus antedates Sayn's specific name by two years.

[2] La Fauna neocomiana de la Cordillera Argentina etc. *Act. Acad. Nac. Cienc. Rep. Argent.*, Vol. IX, p. 62, Pl. II, figs. 8, 8*a* (1925).

belong to quite a different group. It is possible that an *Astieria* sp. ind., figured by Böse[1] from the Valanginian-Hauterivian of Mexico, also belongs to that group, but the poor preservation of most of the Mexican forms makes definite identification impossible. *Astieria atherstoni* (Sharpe), var. *densicostata*, Wegner,[2] better renamed *Olcostephanus densicostatus*, also seems comparable, but it is much more finely ribbed on the earlier whorls.

Horizon.—Neocomian (Belemnite Beds).

Locality.—687 (5, including two doubtful fragments).

14. Olcostephanus radiatus, sp. nov.

(Plate II, fig. 1.)

Diagnosis.—Subplatygyral, pachy- to perpachygyral, sublatumbilicate. Whorl-section reniform, with greatest thickness at rounded umbilical edge and high and steep umbilical wall. About 23 bullate tubercles on umbilical edge, produced radially down to umbilical suture and giving rise to first three, later four, radial secondaries. Occasional deep and oblique constrictions. Suture-line complex, as in the other forms of *Olcostephanus* here described.

Measurements.

	Holotype (Plate II, fig. 1).	
Diameter	66	72 mm.
Height of last whorl	39	39 %
Thickness of last whorl	60	68 %
Umbilicus	34	35 %

Remarks.—Included in the second set of figures is a portion of the outer whorl, omitted in the illustration, but still septate. This species seems to be very close to *O. madagascariensis*, Lemoine,[3] but in the absence of measurements or of a cross-section or peripheral view of the latter, it is not advisable to suggest a possibly entirely fictitious affinity by attaching, even provisionally, the Salt Range form to Lemoine's species. In any case, the latter lacks the almost perfectly radial ribbing of *O. radiatus*, has more numerous tubercles, and a less steep umbilical slope ; and if the (rather inapt) comparison of *O. madagascariensis* with *Simbirskites kowalewskii*, Pavlow,[4] can be taken to indicate a similarity of whorl-shape, *O. madagascariensis* must be considerably less inflated than the present form. Kilian,[5] however, may have been right in stating that Lemoine's species belonged to the group of *Olcostephanus* (*Rogersites*) *atherstoni* (Sharpe) and *O. radiatus* also differs from the Uitenhage form in its radial ribbing, in addition to having a wider umbilicus.

[1] *Bol. Inst. geol. Mexico*, 42, p. 90, Pl. IV, figs. 2-3 (1923).

[2] *N. Jahrb. f. Min.*, etc., I, p. 82, Pl. XVI, fig. 3 (1909).

[3] Études géologiques dans le Nord de Madagascar. Paris, p. 182, Plate I, fig. 3 (1906).

[4] Le Crétacé inférieur de la Russie et sa faune. *Nouv. Mém. Soc. Imp. Natural. Moscou*, Vol. XVI, livr. 3, p. 70, Pl. II, figs. 1*a-e* (1901).

[5] Lethaea geognostica, p. 215 (1910).

O. latiflexus, Baumberger,[1] which also has an open umbilicus (36-38 per cent. of the diameter), differs considerably from the present form in whorl-section: and *O. obliquenodosus*, Retowski,[2] with which the Swiss species had been compared, is not only less radially ribbed than *O. radiatus*, but is generically distinct, being apparently a young *Spiticeras*. The small ammonite from Berrias figured by Pictet[3] as *Amm. astierianus*, but recognised by most subsequent authors as widely different, also has the tubercles in the umbilicus placed well away from the suture, instead of touching it, as in *O. radiatus*, of which the Berrias form is almost a miniature replica. The drawing may not be reliable, of course, but such nuclei of forms of *Olcostephanus* (and *Spiticeras*) are difficult to identify. It may be noted that while Wegner,[4] quite erroneously, included Pictet's Plate XVIII, fig. 3 (but not Plate XVII, figs. 3-4) in *O. schenki*, an exactly opposite (and more correct) view was taken in the following year by Kilian[5] who believed that species to comprise Pictet's Plate XVII, figs. 3-4 only (but not Pl. XVIII, fig. 3). In fact, not one of the three examples is identical with *O. schenki*, as here interpreted (see Plate XVIII, fig. 9); and the original of Pictet's Plate XVIII, fig. 3, which is the only one that can be compared to the present species, seems to me to be merely the young of *O. boussingaulti* (d'Orbigny),[6] an early species of *Olcostephanus*, transitional from *Spiticeras*.

Spiticeras ? detonii, Rodighiero,[7] which is also somewhat intermediate between this genus and *Olcostephanus*, has the radial ornamentation of the form here described, but a much more open umbilicus and it is probably far less inflated. Its comparison to a *Simbirskites* of the *decheni* group, however, was not very apt.

Horizon.—Neocomian (Belemnite Beds).

Locality.—685 (1).

15. Olcostephanus cf. madagascariensis, Lemoine.

(Plate XIX, figs. 3*a*, *b*.)

1906. *Holcostephanus madagascariensis*, Lemoine; Études géologiques dans le Nord de Madagascar, p. 182, Plate I, fig. 3.

1910. *Astieria madagascariensis* (Lemoine) Kilian, *loc. cit.* (Lethaea geogn. II, Vol. III, pt. 3), fasc. 2, p. 215.

An example of about 58 mm. diameter, slightly deformed by pressure near the end, was stated by Folgner to differ so little from the Madagascan type that the creation of a separate species was not justified. I agree; and although

[1] *Abh. Schweiz. pal. Ges.* Vol. XXXV, pt. V, p. 5, Pl. XXVI, fig. 6 (1908).

[2] Die Tithonischen Ablagerungen von Theodosia (Krim). *Bull. Soc. Natural. Moscou*, p. 249, Pl. IX, fig. 18 (1893).

[3] Mélanges paléontologiques. ii. Études paléontologiques sur la faune à *Terebratula diphyoides* de Berrias (Ardèche), p. 85, Pl. XVIII, fig. 3 (1867).

[4] *N. Jahrb. f. Min.*, etc., I, p. 83 (1909).

[5] Lethaea geognostica, II, 3, I, fasc. 2, p. 177 (1910).

[6] Coquilles et Échinodermes fossiles de Colombie (Nouvelle-Grénade). Paris, P. 32, Pl. I, figs. 1-2 (1842).

[7] *Pal. Italica*, Vol. XXV, p. 94, Pl. IX (II), fig. 12 (1922).

the example here figured has a slightly smaller umbilicus (about 33 per cent. of the diameter) than *O. madagascariensis* and a slightly different and closer type of ribbing, it may well be attached to Lemoine's form, pending the discovery of more specimens.

The whorl-section is depressed, the proportion of height to thickness being as 14 to 21, and the venter is broadly arched, but the umbilicus is comparatively shallow, being rather wide for a form of *Olcostephanus*. The strong primary ribs (about 25 to the whorl) are slightly curved and reflexed on the rounded umbilical slope and comparatively long, a feature which separates the present form (and the last two) from the typical *Olcostephanus* of the *astierianus* group. There are two or three secondary ribs to each primary, but the ribs before the deep and oblique constrictions may have five or six, including the thickened branch that borders the constriction. Conversely the ribs that follow the constrictions are single. The suture-line is not clearly visible but half of the outer whorl can be seen to be body-chamber.

Kilian put *O. madagascariensis* into the lineage of *O. atherstoni* (Sharpe) but was not followed in this by Folgner who also did not accept Kilian's comparison of the Madagascan species with *O. guebhardi*, Kilian, and therefore *Rogersites rogersi* (Kitchin).[1] Both these forms are quite different from the species here described and *O. madagascariensis* is the only described species to which it can be attached.

O. radiatus, sp. nov., although similarly close, has a slightly wider and especially deeper umbilicus, with steeper walls, and slightly coarser and less flexuous ribbing. *O. wynnei*, nov., which was included by Folgner in the same small group as the present form, differs considerably in its more open coiling.

Horizon.—Neocomian, Belemnite Beds. (Folgner labelled this form as of Lower Hauterivian age, but it is here taken to be Upper Valanginian.)

Locality.—Chichali Pass (1).

16. Olcostephanus wynnei (Folgner MS.) nov.

(Plate XIX, figs. 6*a*, *b*.)

Diagnosis.—Substenogyral, subpachygyral, sublatumbilicate. Whorl-section depressed, with rounded sides, evenly arched venter and greatest thickness at lateral tubercles. Umbilical wall gently sloping except just above umbilical suture. Primary ribs, about 25 to the whorl, distinct on umbilical slope and terminating in a prominent tubercle a little below the middle of the side. The primary ribs are almost radial, only slightly bent, and give rise each to about three radial secondaries visible also in umbilicus. One deep constriction just after last septum and another, very oblique, at aperture, followed by a lateral lappet. Ribs immediately preceding the constrictions strongly raised. Suture-line not clearly shown.

[1] *Ann. S. Afr. Mus.*, Vol. VII, p. 201, Pl. IX, fig. 3, Pl. X, fig. 2 (1907).

Measurements.

Diameter	44 mm.
Height of last whorl	33 %
Thickness of last whorl	45 %
Umbilicus	42 %

Remarks.—Folgner called this species the most curious among the Salt Range forms of *Olcostephanus*, a species, moreover, that touched on the derivation of "*Astieria*" from *Spiticeras;* but the description was only just begun and it is impossible to discover from other parts of the MS. what Folgner's (and Uhlig's) views were on this point. I am, however, gladly adopting the MS. name, given "in honour of the indefatigable and meritorious explorer of the Salt Range".

This species can only be compared to *O. radiatus*, sp. nov. and *O.* cf. *madagascariensis*; and Folgner, indeed, had united the latter and *O. wynnei* in a group (Formenkreis) of isolated position, "partly with *Spiticeras* characteristics", although in the description of *O.* cf. *madagascariensis* he thought it a mistake on Lemoine's part to compare it to *Spiticeras*. Both the species mentioned, however, have a smaller umbilicus than *O. wynnei* and increase much more rapidly in thickness.

It seems to me that the present form, indeed, resembles species of *Spiticeras* and it can be compared for example to *S.* (?) *detonii*, Rodighiero,[1] with different inner whorls, or to a French (La Faurie) specimen figured by Djanélidzé[2] as *S. bulliforme*, Uhlig, although this has an early bituberculate stage. The Spiti Shales species, described by Uhlig, are perhaps less closely comparable, but it is almost certain that the species here described is of Valanginian age and not Lower Hauterivian, as stated on Folgner's label.

Horizon.—Neocomian, Belemnite Beds.

Locality.—Chichali Pass (1).

17. Olcostephanus (Rogersites) schenki (Oppel).

(Plate II, fig. 6; Plate XVIII, figs. 9-10.)

1863. *Ammonites schenki*, Oppel. Ueber ostindische Fossilreste, etc. *Pal. Mitteilungen*, IV, p. 286, Pl. 81, figs. 4*a-c*.

1892. *Astieria schenki* (Oppel) Pavlow: Argiles de Speeton (*Bull. Soc. Imp. Nat. Moscou*, Nos. 3 & 4, 1891), p. 493.

1903. *Holcostephanus* (*Astieria*) *schenki* (Oppel) Uhlig, *loc. cit.* (*Pal. Indica*, Ser. XV, Vol. IV), fasc. 1, p. 130, Pl. XVIII, figs. 2*a-c* only.

1908. *Holcostephanus schenki* (Oppel) Kitchin, *loc. cit.* (*Ann. S. Afr. Mus.*, Vol. VII, pt. 2), pp. 193, 198, 202-204.

1910. *Holcostephanus schenki* (Oppel) Kilian, *loc. cit.* (Lethaea geognost., II, 3, 1), fasc. 2, p. 177.

1930. *Rogersites schenki* (Oppel) Spath, *loc. cit.* (*Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2), p. 150.

1936. *Rogersites schenki* (Oppel) Besairie, *loc. cit.* (*Mém. Acad. Malgache* fasc. XXI), p. 140 (*pars*).

[1] *Pal. Italica*, Vol. XXV, p. 84, Pl. IX, fig. 12 (1922).

[2] Les *Spiticeras* du Sud-Est de la France. *Mém. Expl. Carte Géol. France*, p. 127, Pl. XIV, fig. 3 (1922).

The fragmentary specimen figured in Plate II, fig. 6 is small but typical, as far as can be seen. It is entirely septate and the suture-line is sufficiently well displayed to corroborate the evidence of the ornamentation. The direction of the costation, whorl-section, and high umbilical slope show good agreement with the corresponding features of the holotype; and the inner whorls can be seen to be perfectly smooth, as in the young *O. geei* figured in Plate VII, figs. 6*b*, *c*. On the penultimate whorl, however, the ribbing is already much coarser than in that species. *O.* (*R.*) *schenki* is thus the most strongly and distantly ribbed form of *Olcostephanus* from the Salt Range and the only species that may be compared to such typical *Rogersites* as *R. modderensis* (Kitchin).[1] This species indeed was based on a specimen (B. M. No. 10976, *ex* Geological Society Collection, originally labelled *Amm. baini*, Sharpe) that had been thought by Pavlow to represent *O. schenki*, but that differs in many respects, as shown by Kitchin. Since, however, no large examples of *O. schenki* have yet been found or recognised, it is uncertain whether it develops the typical *Rogersites* characters, namely a coronate cadicone and vertical umbilical wall, at larger diameters, while retaining coarse ribbing.

Kilian included in the present species two ammonites from Berrias which had been referred by Pictet to *Amm. astierianus*. It will be seen that even the larger and more globular of these two examples is more finely ribbed than the true *O. schenki* and therefore closer to the Madagascan form figured in Plate II, fig. 8 as *O.* cf. *schenki*. Such inner whorls, however, cannot be identified with certainty, for the early volutions of *O. convolutus* and *O. ventricosus*, v. Koenen sp. or of *O. glaucus*, *O. sublaevis*, or of *O. geei*, here described, are essentially similar.

The *Rogersites* aff. *wilmanae* (Kitchin) I[2] figured in 1930 differs from *O.* (*R.*) *schenki* chiefly in having the tubercles closer to the umbilical border and in having plumper saddles. Like the other forms mentioned above, it could easily be taken to represent the inner whorls of a form like Baumberger's *O. atherstoni* (*pars*, *non* Sharpe)[3] which does not appear to me to belong to the same species as the more finely ribbed or less depressed examples attributed to *O. atherstoni* by Baumberger himself, or the holotype of Sharpe.[4] The coarsely ribbed form recently figured by Roman[5] as *Astieria atherstoni*, which is also less inflated than the type, similarly would have inner whorls of the type figured in Plate II, fig. 8. In spite of slight differences, these forms may be compared to *O. imbricatus* (Baumberger),[6] and the fact that Pictet's[7] *Amm. astierianus* from Ste. Croix was included in that species by Baumberger but tentatively in *O. atherstoni* by Wegner shows that, in the Grenoble interpretation, the latter

[1] *Ann. S. Afr. Mus.*, Vol. VII, pt. ii, p. 202, Pl. X, figs. 3, 3*a* (1908).

[2] *Ann. S. Afr. Mus.*, Vol. XXVIII, pt. II, Pl. XV, fig. 2 (Pl. XIV, fig. 4, Pl. XIII, fig. 3) (1930).

[3] *Abh. Schweiz. pal. Ges.*, Vol. XXXIV, pt. 4, Pl. XXIII, figs. 1*a*, *b* (*non cetera*) (1907).

[4] See below, p. 33. Sharpe's reduced (and reversed) figures are very good and the proportions at 140 mm. diameter (·43 —·64 —·21) are almost exactly the same as in the illustrations (reduced exactly one-third).

[5] Sur quelques formes de Céphalopodes de l'Hauterivien de l'Yonne et des régions voisines. *Trav. Lab. Géol. Lyon*, fasc. XXII, Mém. No. 19, p. 21, Pl. IV (1933).

[6] *Abh. Schweiz. pal. Ges.*, Vol. XXXV, pt. 5, p. 14, text-figs. 123-126 (lectotype) (1908).

[7] Description des fossiles du terrain crétacé des environs de Sainte Croix. *Mat. Pal. Suisse*, Pt. II, 2, p. 298, Pl. XLIII, figs. 2*a*, *b* (1860).

species is a more coarsely ribbed form than Sharpe's original. But Pictet's first example (Pl. XLIII, fig. 1) which is the type of *O. leptoplanus*, Baumberger[1] (1908=var. *pictęti*, Wegner, 1909)[2] is a form of the group of *O. psilostomus*, Neumayr and Uhlig, in which the whorl-section is more slender than in *O.* (*R.*) *schenki* or *O.* (*R.*) *wilmanae* (Kitchin), the holotype of which is crushed, and which cannot be made another variety of *O. psilostomus*, as Wegner suggested.

After the above was written I received in the second consignment, among more doubtful fragments, no fewer than five typical examples of *O.* (*R.*) *schenki*, including the two specimens figured in Plate XVIII, figs. 9 and 10, and one large example, the body-chamber of which, however, is partly displaced and crushed. These examples show that the adult *O.* (*R.*) *schenki* differs from *O.* (*R.*) *atherstoni* (Sharpe) merely in being slightly more coarsely ribbed; and both these species are transitional between *Olcostephanus* and the typical *Rogersites*. On the body-chamber the umbilical tubercles are comparatively small, only slightly produced on the steep but not nearly vertical wall, and not distinctly connected with the ribs, not to mention rib-bundles, as in *O. imbricatus* (Baumberger). This large *O.* (*R.*) *schenki*, in fact, is the Grenoble "*O. atherstoni*", above discussed.

Two small fragments in the Wynne collection had not been identified by Folgner whose examples of "*Astieria schenki*" are here believed to belong to other species, notably *O. sublaevis*, nov.

Horizon.—Neocomian (Belemnite Beds).

Localities.—687 (1 and 1 doubtful fragment); 50 (5); also 4 fragments? (685 and 50); Chichali Pass (2).

18. Olcostephanus (Rogersites) cf. atherstoni (Sharpe).

(Plate XX, fig. 3.)

1856. *Ammonites atherstoni*, Sharpe. Description of Fossils from the Secondary Rocks of Sunday River and Zwartkop River. *Trans. Geol. Soc. London*, Ser. 2, Vol. VII, p. 196, Pl. XXIII, fig. 1.

1882. *Olcostephanus atherstoni* (Sharpe) Neumayr, in Holub and Neumayr; Über einige Fossilien aus der Uitenhage Formation in Süd-Afrika. *Denkschr. k. Akad. Wiss. Wien*, Vol. XLIV, p. 272.

1892. *Olcostephanus* (*Astieria*) *atherstoni* (Sharpe) Pavlow (*pars*), in Pavlow and Lamplugh: Argiles de Speeton et leurs équivalents. *Bull. Soc. Imp. Nat. Moscou* (1891), N. S. Vol. V, p. 495 (*non* Pl. XVII, fig. 14).

non 1902. *Holcostephanus* (*Astieria*) cf. *atherstoni* (Sharpe) Karakasch: Note sur le Crétacé Inférieur de Biassala (Crimée). *Trav. Lab. Géol. Univ. Grenoble*, Vol. VI, fasc. 1, p. 103, Pl. I, fig. 3.

non 1902. *Astieria* cf. *atherstoni* (Sharpe) v. Koenen: Die Ammonitiden des Norddeutschen Neocom. *Abh. k. Preuss. Geol. Land. Anst.*, N. F., Heft 24, p. 150.

1903. *Holcostephanus atherstoni* (Sharpe) Uhlig, *op. cit.* (Fauna of the Spiti Shales, fasc. 1), p. 131.

[1] *Abh. Schweiz. pal. Ges.*, Vol. XXXV, Pt. 5, p. 9, Pl. XXVIII, fig. 2 (1908).
[2] *N. Jahrb. f. Min., etc.*, I., p. 85 (1909).

non 1905. *Holcostephanus* (*Astieria*) *atherstoni* (Sharpe) Kilian, *loc. cit.* (*Bull. Soc. géol. France*, sér. 4, Vol. II, année 1902), p. 865, Pl. LVII, figs. 1*a*, *b*.

non 1906. *Astieria atherstoni* (Sharpe) Burckhardt: Faune Jurassique de Mazapil. *Bol. Inst. Geol. Mexico*, No. 23, p. 185, Pl. XI, figs. 2-3.

non 1907. *Astieria atherstoni* (Sharpe) Karakasch, *loc. cit.* (*Trav. Soc. Imp. Nat. St. Pétersb.*), Vol. XXXII, liv. 5, p. 123.

1907. *Astieria atherstoni* (Sharpe) Baumberger, *loc. cit.* (*Abh. Schweiz. Pal. Ges.*, Vol. XXXIV), Pt. 4, p. 40.

1908. *Holcostephanus atherstoni* (Sharpe) Kitchin, *loc. cit.* (*Ann. S. Afr. Mus.*, Vol. VII, Pt. 2), p. 187.

non 1909. *Astieria atherstoni* (Sharpe) Wegner; *op. cit.* (Revision Formes *Astieria*, etc.), p. 10.

1909. *Astieria atherstoni* (Sharpe) Wegner: Übersicht *Astieria*-Formen. *N. Jahrb. f. Min.*, etc. (I), p. 81.

1909. *Holcostephanus atherstoni* (Sharpe) Hatch and Corstorphine: Geology of South Africa, p. 303, text-fig. 76*a*.

1910. *Holcostephanus* (*Astieria*) *atherstoni* (Sharpe) Kilian, *loc. cit.* (Lethaea geognostica, fasc. 2), p. 213.

1910. *Holcostephanus atherstoni* (Sharpe) Uhlig, *op. cit.* (Fauna of the Spiti Shales, fasc. 3), p. 395.

1914. *Holcostephanus* (*Astieria*) sp. (group of *A. atherstoni*, Sharpe) Spitz: Lower Cretaceous Fauna from the Himalayan Gieumal Sandstone, etc. *Rec. Geol. Surv. India*, Vol. XLIV, pt. 3, p. 204.

non 1923. *Astieria* ex aff. *atherstoni* (Sharpe) Böse: Algunas Faunas Cretacicas de Zacatecas, Durango y Guerrero. *Bol. Inst. Geol. Mexico*, No. 42, p. 77, Pl. III, figs. 1-2.

1924. *Rogersites atherstoni* (Sharpe) Spath: Ammonites of the Speeton Clay and Subdivisions of the Neocomian. *Geol. Mag.*, Vol. LXI, p. 87.

1930. *Rogersites atherstoni* (Sharpe) Spath: On the Cephalopoda of the Uitenhage Beds. *Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2, p. 142.

This species was not represented in the first two collections, but the ammonites studied by Folgner included fifteen examples labelled *Astieria atherstoni* or *A.* sp. (group of *A. atherstoni*). There is only one fragmentary example, however, figured in Plate XX, fig. 3, that resembles the holotype of Sharpe's species, before me (B. M. No. C. 32202) and now refigured (Plate XX, fig. 4) although on account of its slender shape and more flattened venter, this fragment could equally well have been included in *O. glaucus*. The presence of one conspicuous constriction is not of significance, for the holotype of *O. atherstoni*, still septate at 140 mm. diameter, is broken and, like the example figured by Baumberger[1], may well have had a constriction on the earlier whorls. The secondary ribbing, moreover, is probably closer on the fragment here figured than on Sharpe's original, which, however, shows fine peripheral ribbing at one stage (after the coarsely ribbed early stage to about 40 mm. diameter) to become coarse once more at about 80 mm. The primary costae also appear to be more prominent in the South African form than on the poorly preserved Salt Range fragment.

[1] *Abh. Schweiz. pal. Ges.* Vol. XXXIV, pt. 4, text-figs. 115-116, p. 44 (1907).

While this example, then, is doubtful, it is still less possible definitely to identify with Sharpe's species a large, fragmentary specimen which at a radius of 85 mm. seems to attain a whorl-thickness of not less than 100 mm. and therefore apparently represents a much more globose species. This thickness is the approximate equivalent of 70 per cent. of the diameter, but at 100 mm. diameter, the thickness also amounted already to about 70 per cent. as against 63 per cent. in *O.* (*R.*) *atherstoni*. This is the largest form of *Olcostephanus* in the Wynne collection but it was left unidentified by Folgner. Unfortunately the only part of the ammonite that is tolerably well preserved is the very deep, funnel-shaped umbilicus of one side and this shows strong primary ribs, straighter and slightly more distant than those of *O.* (*R.*) *atherstoni*, but resembling the umbilicus of certain South African forms of *Rogersites*. The inner whorls appear to have increased in thickness at a more rapid rate than in *O.* (*R.*) *atherstoni*, judging by the height of the umbilical wall of the successive whorls, but the remainder of the specimen is too fragmentary to reconstruct the final shape in a satisfactory manner. The tubercles of the small part of outer whorl that is preserved, however, are very prominent on one side, although the fasciculated ribs seem to be closer and finer than in Sharpe's type. Since it is uncertain whether the poor preservation of this large form and deformation by crushing are responsible for the differences from *O.* (*R.*) *atherstoni* in these characters as well as in thickness and whorl-section, and since it cannot be identified with any of the other species of *Olcostephanus* here recorded from the Salt Range, the example under discussion may be provisionally referred to Sharpe's species. But it is probable that in each area that had its *Olcostephanus* fauna there were developed "*atherstoni*" forms which thus do not constitute a true species but are merely homoeomorphous local variants of the common root-stock. In any case, of all the distinctive South African forms of *Rogersites* only *O.* (*R.*) *atherstoni* has been recorded from places as far apart as Speeton, the Crimea, and Mexico. Even the Madagascan *Olcostephanus* (*Rogersites*)[1] fauna seems to lack the typical elements of the Uitenhage beds, with the exception of this one, common *atherstoni-schenki* type.

Horizon.—Neocomian (Belemnite Beds). The species is undoubtedly Valanginian and does not occur in the Hauterivian, as claimed by Kilian and Reboul.[2]

Locality.—Chichali Pass (2).

Sub-family: *SPITICERATINAE*, Spath, 1925.

Genus: PRONICERAS, Burckhardt (1919), 1921.

19. PRONICERAS INDICUM, sp. nov.

(Plate III, figs. 4*a-d.*)

Diagnosis.—Subplatygyral, subpachygyral, sublatumbilicate. Whorl-section rounded, slightly contracted ventrally, but not forming an actual sharpening of

[1] See H. Besairie: Fossiles characteristiques du Nord et du Nord-Ouest de Madagascar. *Ann. géol. Service des Mines*, fasc. 2, p. 44 (1932).

[2] *Mém. Explic. Carte géol. France*, p. 256 (1915).

the periphery; umbilical wall comparatively high and steep. Single and bifurcating ribs, strongly projected except on umbilical wall and meeting along siphonal line in chevrons directed forwards. Several deep and very oblique constrictions, preceded by trifurcating and followed by single ribs. Sutuer-line not exposed. Aperture and length of body-chamber unknown.

Measurements.

Diameter	18 mm.
Height of last whorl	37 %
Thickness of last whorl	37 %
Umbilicus	36 %

Remarks.—This species is comparable to some of the Mexican forms of *Proniceras* described by Burckhardt,[1] *e.g.* to *P. subpronum*, without, however, being identical with any. The European *P. pronum* (Oppel) Zittel sp.,[2] which as has been pointed out by Uhlig,[3] differs entirely from *Spiticeras* in the development of the young, has more numerous single costae and like the very similar *P. toucasi*, Retowski sp.[4] (="*Holcostephanus*" *pronus*, Toucas,[5] *non* Oppel) is more evolute than *P. indicum*. The excellent illustrations given by Djanélidzé[6] of various French forms of *Proniceras* also show that the present species is quite distinct.

The inner whorls of the only example available appear to be smooth to a diameter of about 4 mm., where there is a deep constriction. The succeeding half-whorl, which represents all that is visible in the umbilicus, is obliquely ribbed and the ribs appear to be single. But in the fragment described below as *Proniceras* sp. ind. the dorsal impression of the inner whorl shows that the bifurcation of one rib (out of four) took place inside the umbilical suture and actually on the ventral area, whereas on the outer whorl the branching occurs low down on the whorl-side. In young *Spiticeras* the primary costae also bifurcate at the umbilical suture but they there develop a tubercle and henceforth the development is entirely different. Apart from the more pronounced peripheral projection of the ribs and the smaller umbilicus, the young *P. pronum* is thus not unlike an immature *Nebrodites* (group of *N. agrigentinus*, Gemmellaro sp.[7]) and this also explains the resemblance to *Idoceras* to which Burckhardt directed attention in the case of his *P. subpronum*. But it would be as rash to derive *Proniceras* from the Idoceratidae as to consider *Spiticeras* a direct

[1] Faunas jurasicas de Symon (Zacatecas), etc. *Bol. Inst. geol. Mexico*, No. 33, pp. 40-50, 1919; Pls. XV-XVI (1921).

[2] Die Cephalopoden der Stramberger Schichten. *Pal. Mitteil.*, 1, p. 91, Pl. XV, figs. 8-10 (1868).

[3] Fauna of the Spiti Shales, fasc. 1, p. 87 (1903).

[4] Die tithonischen Ablagerungen von Theodosia. Ein Beitrag zur Paläontologie der Krim. *Bull. Soc. Imp. Natural. Moscou*, N. S. Vol. VII, p. 251 (as variety). (1893).

[5] Étude de la faune des Couches tithoniques de l'Ardèche. *Bull. Soc. géol. France* (3), Vol. XVIII, p. 596, Pl. XV, figs. 14-16 (1890).

[6] Les *Spiticeras* du S. E. de la France. In Kilian: Contributions à l'Etude des Céphalopodes paléocrétacés du S. E. de la France. *Mém. Explic. Carte géol. France*, pp. 55-84, Pls. I, II, IV (1922).

[7] See Spath, *Monogr. Hunter. Mus. Glasgow*, Vol. I, 1925, p. 130. According to Kilian (Mission d'Andalousie, 1889, p. 646), however, the ventral ribs of the young *P. pronum* are interrupted in the siphonal line.

descendant of *Proniceras*, although this is the phylogeny put forward again by Djanélidzé.[1]

It must, however, be admitted that the inner whorls of an evolute *Spiticeras* like that I[2] figured from the Attock district could be much like the present form.

The resemblance of *P. indicum* to certain Holcodiscids (*Spitidiscus* of the *rotula* group) is entirely superficial and due merely to the constrictions cutting obliquely across the ribbing, a feature again strikingly displayed in certain uppermost Cretaceous Kossmaticeratids.

Horizon.—Tithonian (Base ? of Belemnite Beds).

Locality.—680 (1).

20. PRONICERAS, sp. ind.

(Plate VII, figs. 8*a-d.*)

In the description of the last species reference has already been made to a second and more inflated form of *Proniceras* which, unfortunately, is also represented only by a limonitic fragment, without trace of the suture-line. The whorl-section is rather depressed, the thickness (8·25 mm.) being considerably in excess of the whorl-height (6·25 mm.) and the next inner whorl is still wider, with comparatively slight involution. The ribbing is very similar to that of *P. indicum*, but, owing to the wide periphery, the sinus in the ventral ribbing seems less pronounced and there is a suspicion of a groove in the siphonal line, at least at the larger end. The umbilical wall, on account of the increased whorl-thickness, is also correspondingly higher than in the last species.

There are more bifurcating ribs than in the small *Proniceras* figured by Burckhardt in 1912[3] (as *Holcostephanus* aff. *pronus*, Oppel sp.) and the branching takes place much lower down on the whorl-side, while the section is more depressed. The young examples of *Spiticeras* figured by the same author[4] are much more finely ribbed than the form here described which, moreover, shows no tendency to develop tubercles at the point of bifurcation of the ribs. It is probable that the present form is closer to *P. toucasi* (Retowski) above cited than to any other described species, but in the absence of actual specimens for comparison, I am obliged to rely on Djanélidzé's[5] figures.

Horizon.—Tithonian (Base ? of Belemnite Beds).

Locality.—680 (1).

Genus : SPITICERAS, Uhlig, 1903.

21. SPITICERAS (?) sp. ind. juv.

(Plate VII, figs. 9*a-d.*)

A small whorl-fragment, limonitic and without suture-lines, was at first taken to be one of those late (and often non-tuberculate) forms of *Olcostephanus* which,

[1] *Spiticeras* du S. E. de la France, p. 51 (1922).

[2] Spath, *Pal. Ind.* N. S., Vol. XX, Mem. 4, p. 17, Pl. VI, fig. 8 (1934).

[3] Faunes jurassiques et crétaciques de San Pedro del Gollo. *Bol. Inst. geol. Mexico*, No. 29, pp. 127-8, Pl. XXXV, figs. 4-6 (1912).

[4] *Ibid.*, Pls. XLII-XLIII.

[5] *Spiticeras* du S. E. de la France, Pl. II, figs. 1*a*, *b* ; Pl. IV, figs. 1-4 (1922).

with a similar preservation (originally pyritic), abound in the Lower Hauterivian marls of the south-east of France. There are, however, important differences, and the resemblance is really confined to the very fine ribbing of the inner whorls. That is to say, judging by the impression in the dorsal area of the whorl-fragment, at a diameter of about 7 mm. the ventral ribbing was as close and delicate as that of *Olcostephanus astierianus* (d'Orbigny); but the lateral aspect must have been different. For, at 13 mm. diameter, there are only regular, primary ribs, strongly inclined forwards, and they split up generally into two secondaries. These are only slightly weaker than the primaries, but change direction, and are quite radial. On the periphery the spacing of the ribs is very even, but one rib stands out slightly more prominently and is preceded by a faint constriction. The presence of one triplicate rib on one side causes alternation of the secondaries up to the constriction. There is no tubercle at the point of bifurcation; but this is placed at the point of greatest whorl-thickness, where the very broad periphery and the high umbilical slope meet in a rounded edge, and the point of bifurcation is thus rather prominent. The whorl-thickness at the end is 7·75 mm. and the height 4·25 mm. or from the previous whorl 3·25 mm. so that the involution is light. There is a suspicion of a sulcus in the siphonal line.

There are various depressed forms of Perisphinctids in the material before me, including a fragment from the same locality (believed to have been derived from the equivalent of the Spiti Shales); and the characters just ennumerated seem to place the present fragment with these depressed Perisphinctids, notably forms of the genus *Aulacosphinctoides* (*infundibulus* group).[1] But here again the resemblance seems to be confined to the alternation of the ribs across the periphery, which is found in many Stephanoceratids, from the Bajocian up. The greatest whorl-thickness in *Aulacosphinctoides* is either below the point of bifurcation of the ribs or, where they coincide, it is higher up the whorl-side than in the fragment here figured, producing a less semilunar whorl-shape, and the ribbing is always much coarser. *Virgatosphinctes* of the group of *V. frequens* (Oppel) and *V. subfrequens*, Uhlig,[2] have finer ribbing, but in these also the primary ribs are comparatively long. The small umbilicus of the Salt Range fragment (about 30 per cent. of the diameter) similarly suggests a more olcostephanid shape.

Pending the discovery of more complete material and in view of the absence of the suture-line it must suffice to suggest that the ammonite was probably less closely allied to the Virgatosphinctidae than to those olcostephanid forms of the Tithonian that used to be referred, in the literature as well as in old collections, to *Amm. groteanus* and *Amm. celsus*, Oppel.[3] Inner whorls of these Olcostephanids are difficult to distinguish from Perisphinctids, as is shown, for example, by the misidentification of Pervinquière's[4] Lower Tithonian *Holcostephanus* cf. *celsus*; and, as Djanélidzé[5] has shown, the innermost whorls of the true *Spiticeras celsum* (Oppel) are first smooth, and then coronate, and quite unlike the fragment

[1] Uhlig, Fauna of the Spiti Shales, fasc. 3, p. 371, Pl. LXXII, figs. 1-4 (1910).
[2] *Ibid.*, p. 327, Pl. LXI, figs. 1*a-d*; p. 325, Pl. LXIII.
[3] See in Zittel, Cephalopoden der Stramberger Schichten, p. 90 (1868).
[4] Études de Paléontologie Tunisienne, p. 41, Pl. II, figs. 9*a*, *b*; 10*a*, *b*. (1907).
[5] *Spiticeras* du S. E. de la France, p. 89, Pl. III, figs. 4, 4*a*, *b*. (1922).

here described. But *S. pseudogrotianum*, Djanélidzé,[1] has not only costate but highly inflated inner whorls and the still more Perisphinctoid Crimean forms described by Retowski[2] as *Holcostephanus theodosiae* (*non* Deshayes=*Spiticeras orientale*, Kilian), *H. mirus* and *H.* ? *proteus* also may be expected to have early volutions resembling the form here described. Unfortunately, these forms are as yet incompletely known, as Djanélidzé[3] pointed out; moreover they are always crushed, and the only Crimean example of a *Spiticeras* (*Kilianiceras* ?) of the *theodosiae* group before me (B. M. no. C. 25342) does not show the inner whorls, so that direct comparison is impossible.

The small "*Rogersites* sp.," figured by Besairie[4] from apparently corresponding beds in Madagascar, has strong umbilical tubercles.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (1).

Sub-genus: NEGRELICERAS, Djanélidzé, 1922.

22. SPITICERAS (NEGRELICERAS ?) sp. nov. aff. SUBNEGRELI, Djanélidzé.

(Plate II, figs. 9*a-d*.)

The two fragments here figured are too small to be given a new name. Moreover, the smaller does not show the suture-line, and its umbilical bullae are corroded, so that, on the inner whorl especially, they appear to be mere costae. But there is only the group of *S.* (*N.*) *negreli* (Matheron) to which the fragments can be compared; and the forms of this group are all more evolute, so that the Salt Range form is almost certainly new. The whorl-section is similar to that of *S.* (*N.*) *subnegreli*, Djanélidzé,[5] perhaps slightly more compressed, the height being 20 mm. and the thickness at the umbilical tubercle 15 mm. in the smaller example, but 29 and 26 mm. respectively in the larger fragment (fig. 9*c*). The penultimate whorl is much more rounded, with the thickness (7·5 mm.) almost equal to the height (8 mm.) and the sides are more bulging. The diameter is estimated to have been about 45 mm. and the width of the umbilicus only 30%, as against 39-46% in *S.* (*N.*) *subnegreli* or 43% in the Andalusian form figured by Kilian[6] as *Holcostephanus negreli* (Matheron). The latter, which was said by Djanélidzé[7] to be a new species, intermediate between *Proniceras gracile* and *P. pseudonegreli*, Djanélidzé (both of which are less compressed), differs from the form here described chiefly in having coarser ribbing and more distantly spaced tubercles. The Salt Range form shows at least three ribs to each comma-shaped umbilical bulla, and five to the nodes preceding the very oblique constriction (in both fragments) so that the ribbing is as fine as in *S.* (*Negreliceras*) *planissimum*, Djanélidzé,[8] which, however, has different inner whorls and a very open

[1] *Spiticeras* du S. E. de la France, p. 93, Pl. III, figs. 2*a-c* (3*a*, *b*) (1922).
[2] *Bull. Soc. Imp. Nat. Moscou*, pp. 250-253, Pl. X, figs. 1-4 (1893).
[3] *Spiticeras* du S. E. de la France, p. 189 (1922).
[4] *Mém. Acad. Malgache*, fasc. XXI, p. 137, Pl. XI, fig. 15 (1936).
[5] *Spiticeras* du S. E. de la France, p. 107, text-fig. 23 (1922).
[6] Mission d'Andalousie, p. 646, Pl. XXVII, figs. 5*a*, *b* (1889).
[7] *Spiticeras* du S. E. de la France, p. 74 (1922).
[8] *Ibid.*, p. 113, Pl. IV, figs. 10*a*, *b* (1922).

umbilicus. In spite of the resemblance of the outer whorl and suture-line to *Negreliceras*, reference of the form to *Proniceras* could also be suggested, and a Tithonian rather than an Infra-Valanginian (=Berriasian) age seems indicated.

The resemblance of the present form to *Spitidiscus*, *e. g. S. intermedius* (d'Orbigny)[1] is quite superficial and confined to the occurrence, in both, of oblique constrictions, which, however, are not even of identical structure. Djanélidzé[2] was undoubtedly right in questioning the derivation of *Spitidiscus* from *Spiticeras*, which had been suggested by Kilian[3] who erroneously recorded *Spitidiscus rotula* (Sowerby)[4] already from the Valanginian.

Horizon.—Infra-Valanginian ? (base ? of Belemnite Beds).

Locality.—682 (2).

23. Spiticeras (Negreliceras ?) sp. ind.

(Plate IV, figs. 4*a-b*.)

The example of which two peripheral views are here given is poorly preserved and the sides are coated with firmly adhering matrix. But it can be seen that the ribbing is coarser than that of the form last described. Whorl-shape and involution probably were similar, but as only one or two comma-shaped umbilical ribs are exposed it is impossible to say how far the apparent absence of tubercles is due to the imperfect preservation. The inner whorls which are more rounded, are certainly not tuberculate. They show *Proniceras* ribbing, single and bifurcating, projected on the sides but forming only a slight sinus on the broad periphery, even less pronounced than that of *Spiticeras obliquelobatum*, Uhlig,[5] whereas on the outer whorl it is as acute as in *S. eximium* (Uhlig).[6] No constriction is visible on the (inner) half whorl that is exposed and the umbilicus seems smaller than in any described species of *Proniceras*.

There is a fragment of a larger specimen which is still septate at a whorl-height of about 45—50 mm. so that the complete ammonite must have been as large or larger than the largest known *Negreliceras*. The fragment shows one very oblique constriction which cuts across at least five ribs, but the umbilical edge again is not preserved. The whorl section is as compressed as that of the smaller specimen and the narrowly arched periphery shows chevrons more strongly projected or more acute than those of *S.* (*N.*) *negreli* (Matheron),[7] but this may be a result of the narrowness of the periphery. The suture-line cannot be followed clearly enough for description, but the external lobe is very wide and, considering the narrow venter, the median saddle in the siphonal line is unusually wide. A third septate fragment of a large ammonite, with slightly finer and closer ribs, is still more doubtful, as there are portions of gigantic Neocomitids

[1] Pal. Française, Terr. Crétacé, Vol. I, p. 128, Pl. XXXVIII, figs. 5-6 (1841).
[2] *Spiticeras* du S. E. de la France, p. 41 (1922).
[3] Lethaea geognostica, p. 264 (1910).
[4] See in Pavlow and Lamplugh : Argiles de Speeton, Moscou, Pl. X, figs. 11-12 (1892).
[5] Fauna of the Spiti Shales, fasc. 1, Pl. XVIII, fig. 1*c*. (1903).
[6] *Ibid.*, fig. 3*b*.
[7] See in Djanélidzé, *op. cit.* *Spiticeras* du S. E. de la France, Pl. XVIII, fig. 2*b* (1922).

in the collection which also develop continuous and projected peripheral ribbing; the constriction, however, is characteristic.

Horizon.—Infra-Valanginian (base ? of Belemnite Beds).

Localities.—682 (4 ?); 50 (1).

INCERTAE SEDIS.

24. Gen. nov. ("AULACOSPHINCTES" ?) sp. ind. nov.

(Plate II, figs. 7*a-d.*)

A small, fragmentary, internal cast of an ammonite, preserved in limonite, but with traces of three septal edges, shows a rounded whorl-section and an evenly arched, though slightly flattened, venter. The sides are also greatly flattened; the siphonal line is very slightly sulcate and the umbilical slopes are evenly rounded. The thickness (6·66 mm.) is scarcely greater than the whorl-height (6·33 mm.). The dorsal area is only faintly impressed, the involution being about one-sixth of the whorl-height, and the previous whorl was as rounded as the outer while what remains of the third and innermost whorl shows slightly more depression. Of the seven rather blunt ribs that can be traced continuously, the first, fourth and fifth are bifurcating, the second and seventh are single, and the remaining two are trifurcating, the anterior branch of the trifid ribs being so loosely attached to the posterior fork that it could also be regarded as an intercalated secondary. The second (single) rib is followed by a constriction, not deeply indented, but well marked. The ribs of the two sides are perfectly symmetrical and the primary stem is slightly stronger than the peripheral ribs, but the ribbing is not sharp. The umbilical end of the ribs is strongly projected and continuous to the umbilical suture.

The suture-line shows a comparatively large, irregularly bifid external saddle and a trifid first lateral lobe, as deep as the external lobe. The first lateral saddle is short and bifid, the oblique second lateral lobe is very short and the small second lateral saddle is already on the umbilical slope. There does not appear to be room for auxiliary elements, but the umbilical end of the suture-line is not preserved.

A fragment of a larger ammonite, less favourably preserved than that described above, has slightly less regular but equally blunt and fine ribbing, and the primary ribs end, without projection, on the smooth and steep umbilical wall, some distance from the umbilical suture. There are about nine primaries to sixteen peripheral ribs, or eight bifurcating ribs to one single rib; but the bifurcation takes place at various heights near and above the middle of the side. There is no trace of a constriction and the ribbing of the previous whorl (in the dorsal area) is too insufficiently preserved to be described in detail, but like that of the outer whorl it seems to have been slightly projected ventrally, whereas in the smaller fragment there is a suggestion of a sinus directed backwards in the siphonal line. The siphonal sulcus again is very faint.

The suture-line shows only the external saddle and a comparatively wide, trifid first lateral lobe, almost as deep as the external lobe. The lateral saddles appear to be farther away from the umbilical suture than the corresponding elements in the smaller fragment, but they are not clearly exposed. On the other hand, there are two small and oblique auxiliary lobes on the smooth umbilical wall.

Direct comparison of the two fragments here described with the inner whorls of a considerable number of Spiti Shales Perisphinctids in the British Museum (Natural History) has shown that they are entirely distinct, even such comparatively finely ribbed species of *Aulacosphinctes* as *A. linoptychus* (Uhlig)[1] being far more coarsely and sharply ribbed at a comparable size. The inner whorls of the strongly sulcate *mörickeanus* group to which I previously[2] restricted *Aulacosphinctes*, are still more different, as is *Virgatosphinctes*, with its fine and close ribs; but the form described by Burckhardt[3] as *Perisphinctes* (*Aulacosphinctes*) *wilfridi* from the *Proniceras* beds of Mexico may be closer to the present examples. Its secondary ribs, however, are shorter than those of the Salt Range specimens and the rib-curve is more falcoid; but it is possible that Burckhardt's species which I suggested in 1931[4] might be an *Aulacosphinctoides*, is entirely unrelated.

Since fragments of various species of *Aulacosphinctoides*, some partly limonitised, occurred together with the fauna that included *Proniceras*, *Himalayites*, *Blanfordiceras* and the two fragments above described, it may seem unjustifiable to discuss these separately, and to refer them doubtfully to a new genus; yet they represent only one of a number of Perisphinctid stocks found in the uppermost Tithonian, which are as yet very incompletely known.[5] Thus *Perisphinctes solowaticus*, Bogoslowsky,[6] and *P.* sp. ind. of the same author[7] have some resemblance to the present forms in developing triplicate ribs; but while the former has an entirely different (Craspeditid) suture-line, the latter shows far greater involution. *P. kokeni*, Behrendsen,[8] again, with which *P. solowaticus* had been compared, may have inner whorls like the present fragments, but it also appears to belong to an unnamed genus or sub-genus. The unsatisfactory drawings in some older works, like Steuer's,[9] moreover, make exact comparison impossible and in the circumstances it must suffice merely to record the occurrence of these distinctive forms without giving them a distinct name.

Paraboliceras propinquum (Uhlig)[10] of the Spiti Shales is another comparable, and probably equally transitional, Perisphinctid, and it also has but a very slight peripheral sulcus. It could be suggested that the absence of parabolar markings

[1] Fauna of the Spiti Shales, fasc. 2, p. 358, Pl. XLII, fig. 4 (1910).

[2] *Monogr. Hunter. Mus., Glasgow*, Vol. I, p. 144 (1925).

[3] Faunas jurasicas de Symon (Zacatecas), etc., *Bol. No.* 33, *Inst. geol. Mexico.*, Vol. I, p. 51, 1919, Vol. II, Pl. XVII, figs. 1-3 (1921).

[4] *Pal. Ind.*, N. S., Vol. IX, Mem. 2, Pt. IV, p. 533 (1931).

[5] Compare the fauna recently described by Besairie (*loc. cit.*, *Mém. Acad. Malgache*, fasc. XXI, 1936, pp. 135-137), from presumably corresponding beds in Madagascar.

[6] Der Rjasan-Horizont, seine Fauna, etc., *Mat. Geol. Russl.*, Vol. XVIII, p. 142, Pl. IV, fig. 9; Pl. V, fig. 1 (1897).

[7] *Ibid.*, Pl. V, fig. 2.

[8] Zur Geologie des Ostabhanges der argentinischen Cordillere. *Zeit. Deutsch. Geol. Ges.*, Vol. XLIII, p. 406, Pl. XXIV, figs. 1-2 (1891).

[9] Argentinische Jura-Ablagerungen. *Pal. Abhand.*, Vol. VII, pp. 127-222, Pls. XV-XXXVIII (1897).

[10] Fauna of the Spiti Shales, fasc. 2, p. 287, Pl. XLIV, figs. 5*a*, *b* (1910).

in so small a fragment was merely negative evidence, and in any case, Uhlig's form (which significantly was referred to *Grossouvria* and not to *Paraboliceras*) may also lack the parabolar nodes at a comparable diameter. But the ventral sinus and the closely spaced parabolae of the true *Paraboliceras* before me, even in the young, are quite distinct. Unfortunately the horizon of *P. propinquum* is not known; but *Paraboliceras* occurs both in the Chidamu and the Lochambel stages and is thus likely to be found in an assemblage like that from locality 680.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (2).

Family: *BERRIASELLIDAE.*

Sub-family: *BERRIASELLINAE.*

This sub-family is represented in the present collections by only a few genera, among them *Blanfordiceras*; and as some of the species included in this genus may develop tuberculation at larger diameters, *Blanfordiceras* is not a typical Berriasellid, but a transition to Himalayitinae, as is *Protacanthodiscus*, Spath (genotype *Hoplites andreae*, Kilian) to which one of the forms described below seems to be allied. Moreover, some of the examples here attributed to *Blanfordiceras* have a depressed whorl-section, and lateral tubercles at the point of bifurcation of the ribs, already at a very early stage, so that they differ considerably from *B. wallichi* (Blanford), the genotype. It must not thus be assumed that the aulacosphinctoid Himalayitinae, tending towards exaggeration of the tuberculation, and the hoplitid Berriasellinae, typically flattened, discoidal shells, are sharply separated groups. Since many of the Salt Range forms here referred to the present family are small, or mere fragments of larger ammonites, they are difficult to compare with, for example, large Spiti Shales or Stramberg species, many of which do not show corresponding young stages in sufficient detail. But the preservation of some of the Salt Range forms is rather favourable, so that their description may prove of interest to future workers, who will have more accurate information than is available at present concerning the numerous and very diverse ammonite stocks that existed at the very end of the Jurassic and the base of the Cretaceous periods.

Of the genera of this sub-family previously[1] listed, *Thurmannites* (*olim* "*Thurmannia*") is now restricted and transferred to Neocomitidae; and *Protacanthodiscus*, on account of its affinity with *Neocosmoceras* (="*Octagoniceras*") and the Himalayitinae is now included in the latter. *Andiceras*, Krantz, established since I wrote, is an additional genus of Berriasellinae and it connects by way of forms like *A. trigonostomum*, Krantz,[2] directly with *Aulacosphinctes* and thence the Perisphinctidae. As mentioned below, under *Blanfordiceras* aff. *latidomus* (Uhlig), Himalayitinae are believed to be derived from the same root-stock.

[1] *Monogr. Hunter. Mus., I*, p. 145 (1925).

[2] *Steinmann Festschrift*, p. 451, Pl. XVI, figs. 3-4 (1926).

The genus *Subthurmannia*, nov. (established below for *S. fermori*) is transitional from Berriasellinae to *Thurmannites* and the family Neocomitidae. But the Indian forms now included in this new genus comprise at least one member of probably yet a distinct and more involute group. *Raimondiceras* also is provisionally included in the present sub-family on account of its affinity with *Subthurmannia*, but its relations to *Pfluckeria*, Lisson, and *Lissonia*, Gerth, and, thence, to *Acanthodiscus*, in the restricted sense, have yet to be established.

Genus : BLANFORDICERAS, Cossmann, 1907.

25. BLANFORDICERAS aff. WALLICHI (Gray).

(Plate IV, fig. 6 ; Plate V, figs. 1, 9, 10.)

1934. *Blanfordiceras wallichi* (Gray) Spath ; Jurassic and Cretaceous Ammonites and Belemnites of the Attock District. *Pal. Indica*, N. S. Vol. XX, no. 4, p. 15, Pl. VI, figs. 6*a*, *b*. (See there for synonymy.)

The fragment figured in Pl. V, fig. 1 is entirely septate and though small, and perhaps not identical with the holotype of *B. wallichi*, may yet be attached to this species. The ribs are only slightly interrupted on the periphery, as in other *Blanfordiceras* of the same size, but the bifurcation seems rather more regular and the sides are flatter than in the Spiti Shales material before me. The dorsal area is obscured by matrix and the suture-lines cannot be clearly followed. This first example is preserved in a glauconitic matrix, like the doubtful, younger, specimen figured in Pl. VI, fig. 2 ; but there are limonitic fragments of *Blanfordiceras* in the collection, the most compressed of which show a whorl-thickness of four-fifths of the height, that is, about the same as in the holotype before me (B. M. no. C. 5041). The costation, on the other hand, seems more irregular ; and one of the figured specimens (Pl. IV, figs. 6*a*, *b*), for instance, on the opposite side, shows two bifurcating ribs with three single costae between them. As I pointed out, however, on a previous occasion, Uhlig himself had stated that not one of his many examples was identical with Gray's holotype and G. Boehm's[1] *Blanfordiceras* from the Dutch East Indies may also all be slightly different.

A small fragment, the suture-line of which is here figured (Pl. V, fig. 6), has rather strongly marked peripheral tubercles ; and another, limonitic specimen, with greater inflation, is transitional to the form described below as *B.* cf. *acuticosta* (Uhlig). Both suture-lines and the periphery in the young (compare Uhlig's Pl. XXVIII, fig. 3*b* and Pl. LXXXIII, fig. 2*b*) show that, contrary to Krantz's[2] views, the true *Blanfordiceras* has nothing whatever to do with *Pseudoblanfordia*, Spath (=group of *Hoplites australis*, Burckhardt) of the Upper Valanginian, nor with *Hoplites wallichi* (*non* Gray) of Steuer[3] (=*H. steueri*, Uhlig) which was considered by Krantz[4] to resemble his *Berriasella steinmanni* of the Upper Tithonian.

[1] Grenzschichten zwischen Jura und Kreide. *Beitr. Geol. Niederl. Ind.* I, 1. Palaeontogr. Suppl. IV, p. 31 ; Pls. III-V, text-figs. 7-9 (1904).

[2] Die Ammoniten des Mittel-und Ober-Tithons, in Jaworski, Krantz and Gerth. Beiträge zur Pal. und Strat. des Lias, Doggers, Tithons und der Unterkreide in der Kordillere, etc. *Geol. Rundschau* (*Steinmann Festschrift*), p. 476 (1926).

[3] Argentinische Jura-Ablagerungen, p. 184 (58) ; Pl. XXX (XVI), figs. 1-3 (1897).

[4] *Steinmann Festschrift*, p. 440 (1926).

In the Wynne collection there is a fragment of a large form which had been labelled by Folgner "*Crioceras* sp. related to *C. torulosum*, d'Orbigny" (*sic*). It is very badly preserved, and while in side-view it resembles a fragment of that species figured by v. Koenen[1], it has a deeply excavated dorsal area, so that it cannot be a Crioceratid. In his description, consisting of one unfinished sentence, this fragment was given a new specific name, but Folgner mentioned that he was at first inclined to identify "this new form of *Crioceras* with *Neocomites longinodus*, Neumayr and Uhlig". It is difficult to say whether the ribbing was originally as straight as that of v. Koenen's form or as flexuous as that of Neumayr and Uhlig's[2] species. The fragment may well have belonged to a large form of *Blanfordiceras*, but it is really quite indeterminable, owing to its incompleteness and bad preservation.

Horizon.—Tithonian (base ? of Belemnite Beds).

Localities.—673 ? (1); 680 (4); 687 (2); 687*a* (1); 685 ? (1, transitional to *Thurmannites* ?); 768 (2); 791 (1 ?); Chichali Pass (1 ?).

26. Blanfordiceras, sp. nov. ?

(Plate V, figs. 11*a-b*.)

The only example available is small and shows no trace of the suture-line; and it is only the somewhat unusual ribbing and periphery, combined with the compressed whorl-shape, that suggest a distinct species. The proportions of the specimen are as follows:—

Diameter . . .	21 mm.
Height of last whorl	38%
Thickness of last whorl .	33%
Umbilicus	40%

The whorl-shape is elliptical, with the greatest thickness (at the point of bifurcation of the ribs) at the middle of the side; and the lower half is slightly less bulging than in the similar *B. acuticosta* (Uhlig).[3] The venter is deeply and very narrowly sulcate, with the terminations of the ribs forming two projecting rows of sharp bullae, meeting at right angles to the siphonal groove. These tubercles are much higher and closer together than in *B. acuticosta*. On the whorl-sides the ribs are single and bifurcating and the ribs of the two sides are very nearly though not perfectly symmetrical. The umbilical slope is well defined.

The form here described is much more evolute than *B. wallichi* (Gray) and especially the young form figured by G. Boehm;[4] but the same author's third and larger example (Pl. IV, fig. 3) has inner whorls with a similar compressed whorl-section. Most of the Spiti Shales species described by Uhlig are more

[1] *Abhandl. k. preuss. geol. Land. Anst.*, N. F., Heft 24, Pl. XV, fig. 4*a* only (1902.)

[2] *Palæontographica*, Vol. XXVII, p. 172; Pl. XVI, fig. 3; Pl. XXXVII. figs. 2-3 (1881).

[3] Fauna of the Spiti Shales, fasc. 2, p. 201, Pl. XXXVII, fig. 2*b* (1910).

[4] *Palæontogr.* Suppl. IV. Pl. IV, figs. 5*a*, *b* (1904).

inflated and the form described above as *B.* aff. *wallichi* has less prominent peripheral ribs and a less deep and narrow groove.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (1).

27. Blanfordiceras cf. acuticosta (Uhlig).

(Plate VI, figs. 10, 13, 14.)

1910. *Hoplites (Blanfordia) acuticosta*, Uhlig : *op. cit.* (Fauna of the Spiti Shales), fasc. 2, p. 201, Pl. XXXVII, figs. 2*a-c*.

1936. *Blanfordiceras acuticosta* (Uhlig) Besairie, *loc. cit.* (*Mém. Acad. Malgache*, fasc. XXI), p. 136, Pl. XI, figs. 17-18.

Some fragments of *Blanfordiceras*, less compressed than those last described and with very sharp ribs, may be compared to the above species and perhaps even more appropriately to the allied *B.* n. sp. aff. *acuticosta*, described and figured by Uhlig.[1] The thickness is equal or almost equal to the whorl-height, but there are transitions to *B.* aff. *wallichi* and probably to *B. rotundidoma*, Uhlig,[2] which has the irregular costation of, for example, the original of Pl. VI, fig. 14. In other doubtful fragments the ribs are more regularly bifid. The specimen represented in fig. 13 has the ribbing continuous across the periphery, but the asymmetry of the latter shows it to be a malformation. A similar fragment, with more compressed sides and the ventral ribbing only slightly interrupted, may, however, have belonged to a form of *Berriasella* rather than a *Blanfordiceras* (compare Pl. IV, fig. 7).

The suture-line of the example figured in Pl. VI, fig. 14 is represented (enlarged and somewhat diagrammatically) in fig. 14*c* and shows good general agreement with that of the Himalayan forms, including Gray's type of *B. wallichi*, with half a whorl of body-chamber. The suture-line of an East Indian example of *Blanfordiceras* of the *wallichi* group figured by G. Boehm[3] seems to differ merely in having a less high first lateral saddle.

Horizon.—Tithonian (base ? of Belemnite Beds).

Localities.—678 ? (1); 680 (5 and some doubtful fragments); 687 ? (1).

28. Blanfordiceras cf. boehmi (Uhlig).

(Plate IV, fig. 5; Plate V, fig. 2; Plate VI, figs. 5, 11, 12, 15.)

1910. *Hoplites (Blanfordia) boehmi*, Uhlig; *op. cit.* (Fauna of the Spiti Shales), fasc. 2, p. 195, Pl. XXXIV, figs. 1*a-d*.

1928. *Blanfordia boehmi*, Uhlig. Grabau, Stratigraphy of China, Vol. II, p. 487, text-fig. 6 ii.

1934. *Blanfordiceras* aff. *boehmi* (Uhlig) Spath; *op. cit.* (Ammonites and Belemnites from the Attock Dist.) p. 16, Pl. VI, figs. 7*a-c*.

The second largest (Pl. IV, fig. 5) of the eleven examples now attached to this species differs from the fragment previously figured in having the ribs more

[1] Fauna of the Spiti Shales, fasc. 2, p. 203; Pl. XXII, figs. 4*a-c*; Pl. XXVIII, figs. 3*a-c* (1910).

[2] *Ibid.*, p. 189; Pl. LXXXIII, figs. 1-2.

[3] *Palæontogr.* Suppl. IV, p. 34, text-fig. 8 (1901).

distinctly inclined forwards, but the peripheral aspect is identical. The prominent and regular lateral tubercles, the peripheral groove, and the suture-line (Pl. V, fig. 2) indicate that the fragments are not referable to *Micracanthoceras*, but some of the smaller among them, with single ribs, are very close to a young *Himalayites* figured by Uhlig,[1] except in the depth of the external lobe. The fragments vary somewhat in cross-section, and while at least one is as depressed as the inner whorls of the largest example (thickness=12-14 mm., height=8-9 mm.), others are less inflated. The inner whorls figured in Pl. VI, figs. 15*a-d* are slightly malformed, the groove not being in the median line; like some other and similar inner whorls, it is attached to the present form rather than any other species of *Blanfordiceras* merely on the basis of the cross-section.

A nearly complete, but badly preserved, septate example of 51 mm. diameter has the secondary ribs strongly drawn forwards, as in *B. wallichi*, and the lateral tubercles are feeble, but it is also included here on account of its low whorls.

The form described below (*B.* aff. *latidomus*) has much coarser ribbing, but one of the fragments, with prominent peripheral tubercles, may be transitional to the form figured by Uhlig[2] as *Hoplites* (*Blanfordia*) n. sp. aff. *acuticosta*.

Horizon.—Tithonian (base ? of Belemnite Beds).

Localities.—678 ? (1); 680 (7); 682 (1); 687*a* (1); 699 ? (1).

29. Blanfordiceras aff. latidomus (Uhlig).

(Plate V, figs. 12*a*, *b*.)

1910. *Hoplites* (*Blanfordia*) *latidomus*, Uhlig, *op. cit.* (Fauna of the Spiti Shales), fasc. 2, p. 196; Pl. XXXV, figs. 1*a-c*.

The example here figured is considered to represent a portion of the inner whorls of *B. latidomus* (Uhlig), or at least a close ally. It has a similar wide peripheral groove, but the terminal spines of the ventral ribs are more prominent on the figured side as a result of a slight malformation. On the opposite side of the ventral sulcus, the bullae are as low as in Uhlig's form. The ribbing is similar, but the whorl-section is different; the thickness is only slightly more than the height, but owing to the lateral tubercle being low on the figured side and high on the opposite side, the octagonal symmetry of the section is affected. Owing to this malformation the umbilical slope of the side not figured is also more bulging. The fragment is septate, and what can be seen of the comparatively simple suture-line agrees with the identification here suggested, although the specimen is of course too fragmentary for definite inclusion in Uhlig's species.

There is little resemblance to *Hoplites rooseboomi*, G. Boehm,[3] which Uhlig had thought nearly allied to his form; but the fragment is of interest on account of its resemblance to certain species of *Corongoceras*, Spath. There is a fragment (B. M. No. C. 20020) before me from Corongo, Peru, of a form of

[1] Fauna of the Spiti Shales, fasc. 2, p. 150; Pl. XXXVIII, figs. 5*a-d* (1910).
[2] Fauna of the Spiti Shales, fasc. 2, p. 203; Pl. XXVIII, figs. 3*a-c* (1910).
[3] *Palæontogr.* Suppl. IV, p. 34; Pl. VI, figs. 1*a*, *b* (1904).

the *mendozanum* group, which is remarkably like the fragment here described, but has more projecting lateral tubercles. Judging, however, by another example (B. M. No. C. 20024) of *Corongoceras*, more evolute than the type of *C. lotenoense*, Spath,[1] the peripheral tubercles also are different. This second specimen, fortunately, retains, in the matrix of a split nodule, the very long and rursiradiate spines that were attached to what, on the solid specimen, appear to be mere transverse bullae, a feature entirely unknown in the more hoplitid *B. wallichi*. This is an important distinction, in addition to the suture-line. Krantz[2] suggested that *Corongoceras* seemed to be more appropriately included in Berriasellinae than in Himalayitinae; but like *C. köllikeri* (Oppel)[3] or the transitional species of *Blanfordiceras* here described, it merely shows that the two sub-families are closely related. *Corongoceras*, like *Micracanthoceras*, connects directly with *Aulacosphinctes*, but since Berriasellinae are derived from the same perisphinctoid root-stock, intermediate types are to be expected. Whether, however, the resemblance to *Corongoceras* may be taken to date the specimen here described, is rather more doubtful, although a horizon somewhere within the *privasensis* zone in the wider sense is indicated.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (1).

30. Blanfordiceras (Gen. nov. ?) sp. nov.

(Plate VI, fig. 9; Plate XVIII, figs. 7*a*, *b*.)

This form is interesting because it shows the close affinity of *Blanfordiceras* to the Himalayitinae. The inner whorls, with a general resemblance to the form described below as Gen. nov. (*Neocosmoceras* ?) sp. ind. (No. 52), have first single, then single and bifurcating ribs, and there is a prominent lateral tubercle on every rib, while a second tubercle is developed where the ribs end at the deep siphonal groove. The outer tubercles, however, are not only of different strength, with, at intervals, a pair of very large and blunt nodes, but some of the ribs between the two tubercles are fibulate, as in *Protacanthodiscus* (?) sp. ind. (No. 47). On the outer whorl, still entirely septate, the ribbing is regularly biplicate and while the lateral tubercle persists, though gradually diminishing, the peripheral tubercles have almost entirely disappeared. There is at least one slight constriction, and the siphonal groove remains deep and wide. The suture-line is not clearly exposed.

Until I received the larger fragment figured in Pl. XVIII, fig. 7, I provisionally included the smaller fragment (Pl. VI, fig. 9) in *Blanfordiceras* cf. *acuticosta* (Uhlig), but the inner whorls show greater resemblance to a young *Himalayites* nov. sp. ind., described by Uhlig,[4] than to such immature *Blanfordiceras* as those figured in Pl. V, figs. 10 and 11. In the gigantic *Hoplites* ("*Blanfordia*")

[1] See in Haupt: Beiträge zur Fauna des oberen Malm und der unteren Kreide in der argentinischen Cordillere. *N. Jb. f. Min., &c.*, Beil. Bd. XXIII, p. 201, Pl. IX, figs. 7*a-e* (as *Hoplites köllikeri*, Oppel sp.). (1907).

[2] *Steinmann Festschrift*, p. 444 (1926).

[3] In Zittel, Stramberger Schichten, Pl. XVIII, figs. 1, 2 (1868).

[4] Fauna of the Spiti Shales, fasc. 2, p. 150; Pl. XXXVIII, figs. 5*a-c* (1910).

celebrant, Uhlig,[1] the ventral tubercles of the inner whorls gradually disappear with age, as in the present form; but the lateral tubercle increases in strength and the whorl-section becomes increasingly more depressed, both of which features are just the reverse of what is found in the species here discussed. The immature examples here tentatively referred to *B. boehmi* (Uhlig) have intermediate single ribs and their peripheral tubercles are more nearly equal than those of the present Salt Range form; moreover in *B. boehmi*, the lateral tubercle also increases in strength with age. It is thus probable that the (much more distantly costate) form described by Uhlig[2] as *B.* sp. nov. aff. *acuticosta* is still the only ammonite to which the present species can be compared; but the sudden change in ornamentation of a form like *Himalayites ventricosus* (Uhlig)[3] suggests caution in dealing with fragmentary material of ammonites belonging to these two related stocks.

The fragment illustrated in Pl. XX, figs. 7*a*, *b* probably belongs to the present species, although owing to its larger size, the rather rigid costation has become more irregular than it is in the example figured in Pl. XVIII, fig. 7. There are some single ribs and in the bifurcating costae the forward branch continues the main rib, the rear branch being slightly disconnected. The peripheral aspect, with its ribs meeting at an angle of about 160° at the deep ventral furrow, as in *B. wallichi*, is also almost identical with that of the original of Pl. XVIII, fig. 7, which, however, has the ribs in line. The suture-line is well shown and has an external lobe almost as deep as the trifid first lateral lobe, slender and comparatively long lateral saddles and two oblique auxiliary lobes. The general plan is that of the suture-line of *B. wallichi*.

This largest fragment was the only "*Blanfordia*" in the Wynne collection and it was described by Folgner as a new form and given a MS. name (in his list of species). He thought that the closest ally of his new form was *B. acuticosta* (Uhlig), but the rigidity and sharpness of the ribbing rather separate the Salt Range species from the typical *Blanfordiceras*. In Uhlig's Himalayan forms of *Berriasella* also, as in the Madagascan example figured in Pl. XIV, figs. 3*a*, *b*, the ribs are more flexuous though as sharp as those of the fragment here described. Since not even the dorsal area of the latter could be exposed, it is clearly inadvisable to give it a new name.

Horizon.—Belemnite Beds, conglomeratic base?

Localities.—768 (1); 680 (1); Chichali Pass (1?; in Folgner's MS. the locality is given as Mulakyl [=Malla Khel], together with '*Lytoceras*' *punjabense*).

Genus SUBTHURMANNIA, nov.

Genotype.—*S. fermori*, sp. nov., p. 53, Pl. IX, fig. 1.

Diagnosis.—Rather evolute Berriasellinae, with *Thurmannites*-stage in young, but returning to ancestral rounded periphery, with or without siphonal band or sulcus, in adult. Bidichotomy of ribbing generally confined to earlier

[1] Fauna of the Spiti Shales, fasc. 2, p. 199, Pl. XXXVI, figs. 1*a-e* (1910).
[2] Fauna of the Spiti Shales, fasc. 2, p. 203, Pl. XXVII, figs. 4*a-c*; Pl. XXVIII, figs. 3*a-c* (1910).
[3] *Ibid.*, p. 145, Pl. XXXVIII, figs. 4*a-d*.

whorls, degenerating more or less quickly to irregular or obsolescent ornamentation. Suture-line complex, similar to that of *Thurmannites* and *Substeueroceras*.

Remarks.—The genus *Thurmannia*, Hyatt, 1900 (changed to *Thurmannites* by Kilian and Reboul in 1914, on account of pre-occupation) was created for *Amm. thurmanni*, Pictet and Campiche, a species which, after Kilian[1] and Baumberger[2], is still rather comprehensively interpreted. Uhlig[3] when discussing the genus in 1905, included in it, among other forms, *T. boissieri* (Pictet), *T. albini* (Kilian), *T. paquieri* (Simionescu), and *T. rarefurcata* (Pictet), representing four distinct types of ornamentation. Uhlig's admission that *Thurmannites* was not sharply separated from, for example, his group of *Neocomites theodorii* (Oppel) is also significant. For, while the restricted *Thurmannites* is connected by many transitions with such allied genera as *Neocomites*, *Odontodiscoceras*, *Sarasinella*, etc., it is rather distinct from the costate *T. rarefurcata*, the tuberculate *T. paquieri*, or the perisphinctoid *T. albini*. It seems to me that if Sayn's[4] work, with its excellent photographs, had been available to Uhlig, he would have recognised that *Thurmannites* is inseparable from the Neocomitids, *i.e.*, *Neocomites* and its allies, but that it differs from the evolute *boissieri* group, although this is probably ancestral. Moreover, since Sayn's[5] own *T. boissieri* is apparently a member of the restricted *Thurmannites*, not of the earlier *boissieri* group, confusion is possible, even with well preserved material. Most of the Salt Range material is in a far from satisfactory state of preservation, but the peripheral views of the forms of *Subthurmannia* here figured, as of Pictet's holotype of *S. boissieri*, are so distinct from those of the later *Thurmannites thurmanni*, as defined below, that separation seems well justified.

I[6] included *Thurmannites* in Berriasellidae in 1925, since it then comprised the *boissieri* group, but in the restricted sense, *Thurmannites* should be referred to Neocomitidae. *Subthurmannia*, on the other hand, better remains in Berriasellinae with its ally *Substeueroceras*; and although the separation in different families may occasionally break down, especially with transitional forms, the number of genera in each is now so large that an arbitrary division will have to be made.

Folgner referred most of the 30 specimens of *Subthurmannia* in the Wynne collection to R. Douvillé's genus *Favrella*, 1909, after first giving a new generic name to the forms grouping themselves round *Neocomites americanus* and *N. wilckensi*, Favre[7]. One of the Salt Range fragments was indeed listed as *F.* sp. nov. aff. *wilckensi* and another was described as *F.* aff. *angulatiformis* (Behrendsen)[8], but on the labels different names, including eight new species, appear, so that it is impossible now to identify the specimens. I can see nothing in the

[1] *Bull. Soc. Statist. Isère*, 3, Vol. XVI, p. 7, Pls. III-V (1892).

[2] *Mém. Soc. Pal. Suisse*, Vol. XXXII, p. 57, Pl. VI, fig. 5; Pl. X, fig. 6 (1906).

[3] *Sitz.-Ber. k. Akad. Wiss.*, Wien, Vol. CXIV, 1, p. 616 (1905).

[4] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2 (1907).

[5] *Mém pal., Soc. géol. France*, Vol. XV, fasc. 2, Pl. VII, fig. 16 (1907).

[6] *Monogr. Hunter. Mus., Glasgow Univ.*, No. 1, p. 145 (1925).

[7] Die Ammoniten der unteren Kreide Patagoniens. *N. Jahrb. f. Min.*, etc., Beil. Bd. XXV, pp. 613, etc., Pls. XXXII-XXXIII (1908).

[8] Zur Geologie des Ostabhanges der argentinischen Cordillere. Part II. *Zeitschr. Deutsch. Geol. Ges.*, Vol. XLIV, p. 16, Pl. IV, figs. 2*a-c* (1892).

collection either resembling Behrendsen's species or fitting the description; and *F. wilckensi* also seems to me to be quite unlike any of the Salt Range forms. It must be admitted that Folgner's material was rather poorly preserved, the best fragment being that figured in Pl. XXI, fig. 2; and since he had no inner whorls except the original of Pl. XX, fig. 5 (identified by him as *Thurmannia* sp.), Folgner could not satisfactorily place these forms of *Subthurmannia*. But the suture-line of *F. americana* (Favre) alone is against any close connection between *Favrella* and *Subthurmannia* and the inner whorls of a species like *S. lissonioides* (Pl. VIII, fig. 4) confirm the distinctness of the two stocks, although both may be Berriasellid developments. I may add that Folgner's material could without difficulty be included in the species which I had made for the more favourably preserved specimens of the first two collections.

31. Subthurmannia media, sp. nov.

(Plate VIII, figs. 1*a*, *b*.)

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate. Whorl-section compressed, with flattened sides, evenly rounded venter and high and steep umbilical wall with rounded edge. Siphonal line first distinctly, later faintly, sulcate, but ribbing continuous across venter, with chevrons directed forwards, in adult. Lateral ribs dichotomous and bidichotomous, inclined forwards, especially on periphery, and slightly flexuous, tending to become irregular at larger diameters. Tubercles, at umbilical end of some of the branching ribs, not very prominent. Suture-line complex, apparently as in other species of *Subthurmannia* here described.

Measurements.

Diameter	77 mm.
Height of last whorl	38%
Thickness of last whorl	30%
Umbilicus	32%

Remarks.—The holotype of this species is entirely septate, as are the other fragments listed below, and as in the case of the specimens attached to the form described below as *S. lissonioides*, some of the larger fragments are doubtful. The degeneration of the ribbing only begins near the end of the holotype specimen and it is difficult to say whether the larger fragments with obsolescent ribbing belong to the present species or to various transitional forms between *S. media* and the other forms here described, especially *S. filosa* and *S. lissonioides*. Half of an ammonite (from locality 700) of about 140 mm. diameter, with less flexuous costation than the typical *S. lissonioides*, seems to be such a transition between the two species; but a small fragment of a similar form had been labelled by Folgner "*Leopoldia* sp. ind.". At least one of the fragments, with a whorl-height of 52 mm. and a thickness of 37 mm., but the typical cross-section of *S. media*, may be merely a less strongly ribbed variety of *S. fermori*.

The present species is a close ally of *S. boissieri* (Pictet)[1], which differs chiefly in having a wider umbilicus and less inclined costation. The Himalayan form described by Uhlig[2] as *Hoplites* (*Thurmannia*) *boissieri* is probably also very close. I am figuring (Pl. IX, figs. 4*a*, *b*), for comparison, what I take to be an immature example of the same form; and it will be seen that it differs from *S. media* only in its more flexuous costation. This Himalayan specimen had already been figured by Blanford[3] as *Amm. wallichi* (Gray) but the (reversed) figure is quite unrecognisable.

Amm. rarefurcatus, Pictet[4], while allied to the form here described, is less close than is *S. boissieri*, since it lacks the umbilical nodes and the distinct bidichotomy of the ribbing of the inner whorls. The last half-whorl of the holotype of *S. media*, however, seems to show the *rarefurcatus* type of ornamentation, with single costae; only all the ribs are strongly inclined forwards. The whorl-section and peripheral view are similar in the two species.

Among six examples in the Wynne collection (five of them labelled "*Favrella* sp. nov. I" and "*F.* sp. ind.") there were the inner whorls figured in Pl. XX, fig. 5, which had been identified by Folgner as "*Thurmannia* sp." While they cannot be definitely assigned to the present species rather than to one of the passage-forms to *S. filosa* and *S. lissonioides*, above discussed, it is clear that they are the inner whorls of a form of *Subthurmannia* of the *rarefurcata* type and the resemblance to the restricted *Thurmannites* as interpreted by Sayn is superficial.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—682 (3); 687 (5); 700 (2); Chichali Pass (7).

32. Subthurmannia patella, sp. nov.

(Plate VIII, figs. 2*a*, *b*.)

Diagnosis.—Closely allied to last species (*S. media*), but with slightly different proportions, a more compressed whorl-section, more narrowly arched periphery and finer and closer costation on the inner whorls. Suture-line complex, with deep, trifid first lateral lobe and narrow-stemmed external saddle.

Measurements.

Diameter	78 mm.
Height of last whorl	40%
Thickness of last whorl	28%
Umbilicus	33%

Remarks.—This species is also closely related to *S. lissonioides* which, however, acquires pronounced peripheral projection of the ribbing at an early stage.

[1] Mélanges paléontologiques, II, p. 79, Pl. XV, figs. 1-3 (1867). Kilian (Lethaea geognostica, Pl. I, 1910) copied Pictet's figs. 1*a* & 1*c* (not 3), reduced to $\frac{2}{5}$ (not to $\frac{1}{2}$) of the natural size, but mixed up the peripheral views of *H. boissieri* and *H. occitanicus*.

[2] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 233, Pl. LXXX, figs. 1*a*, *b* (1910).

[3] In Salter and Blanford: Palaeontology of Niti, etc., 1865, p. 84, Pl. XIX, fig. 2, only. See also Crick: Cephalopoda in the Strachey Collection from the Himalaya. *Geol. Mag.* Dec. V, Vol. I, p. 14 (1904).

[4] Mélanges paléontologiques, II, p. 82, Pl. XVI, figs. 2*a*, *b* (1867).

S. filosa is much more finely ribbed. *Amm. occitanicus*, Pictet[1], with a similar whorl-section, somewhat resembles the form here described, but it is more involute and has more distinct umbilical nodes. If the present species showed a similar tendency to loss of ribbing on the outer whorls, then it is possible that at least some of the large, smooth fragments, tentatively attached to *S. filosa*, should be referred to *S. patella*. But those large fragments (*e.g.*, 685 m.) that could represent adult individuals of the present form by their whorl-section, loss of ribbing on the whorl-side, and faint nodes on the well-marked umbilical rim, show a more pronounced projection of the peripheral ribs than the holotype and, except for the fineness of the ribbing, might well be identified with *S. occitanica*.

It is possible that some of the Mexican ammonites described and figured by Aguilera[2] are related to forms of *Subthurmannia* here described; but the illustrations are such that it is out of question to recognise any of them with certainty, even those that have been referred by Burckhardt[3] to the genus *Kossmatia*.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—685 (1); 687 (1).

33. Subthurmannia lissonioides, sp. nov.

(Plate VIII, figs. 3-4.)

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate, in young, later sublatumbilicate. Whorl-section compressed, with gently flattened sides and high and steep umbilical wall, but rounded edge. Evenly arched venter, with a distinct siphonal groove in young; this groove at about 60 mm. is reduced to a mere smooth, siphonal band, and, in adult, ribbing is continuous across periphery, with a strong forward projection. Lateral ribs flexuous, first bifurcating and bidichotomous, rarely single; later more irregular, with many single ribs. Faint nodes where some of the ribs come together at umbilical edge. Suture-line complex, with deep, trifid, first lateral lobe and slender saddles.

Measurements.

	Holotype.	Paratype.
Diameter	68(47) mm.	145 (?) mm.
Height of last whorl	43%	34%
Thickness of last whorl	32%	26%
Umbilicus	29%	39%

Remarks.—The two specimens here figured seem rather different and the measurements apparently do not agree, but this is merely a matter of size. The inner whorls of the paratype, figured separately in Pl. VIII, figs. 3*b*, *c*, show that it belongs to the same form as the holotype, the final portion of which has been omitted in the figure. Some of the specimens listed below, however, are

[1] Mélanges paléontologiques, II, p. 81, Pl. XVI, figs. 1*a-c* (1867).

[2] In Castillo and Aguilera; Fauna fosil de la Sierra de Catorce, San Luis Potosi. *Bol. Com. geol. Mexico*, No. 1, p. 55, Pls. I-XXIV (1895).

[3] Faunes jurassiques et crétaciques de San Pedro del Gallo (Durango). *Bol. Inst. geol. Mexico*, No. 29, p. 132 (1912).

more doubtful, since *S. media* and *S. patella* are also close to the present form, and mere fragments are difficult to distinguish.

The body-chamber fragment figured in Pl. XXI, fig. 2 (labelled with a new MS. name of *Favrella* by Folgner) well shows the peculiar ribbing of the present form, reminiscent of that of *Paraboliceras* of the Upper Jurassic. The ribbing of this fragment, however, is less inclined than that of the paratype, while the difference in the strength of the costae is due to the latter specimen retaining the test.

S. filosa is far more finely ribbed and has strongly projected and continuous peripheral ribbing already at a very early stage, but one of the doubtful fragments, with finer ribbing than the paratype, may be a transition to that species. Conversely *S. fermori* is more coarsely ornamented, as are the two *S.* spp. ind. described below.

There is some resemblance between the present form and *Lissonia riveroi* (Lisson)[1], but it is confined to the peripheral projection of the ribbing and *Lissonia* has a deep ventral groove even in the adult[2]. The resemblance to species of *Kossmatia* is also superficial, but *Reineckeia* (*Andiceras*) *incerta*, Steuer[3] is probably more closely related to the forms of *Subthurmannia* here described. It has a more narrowly arched periphery than *S. lissonioides* and the costae of the outer whorl are not so much inclined forwards, but its earlier whorls are much more coarsely ornamented than those of any Salt Range form of *Subthurmannia*. In species of *Substeueroceras*[4] with a somewhat similar lateral aspect in the adult, the inner whorls are much more finely ribbed and more like *Berriasella* than *Thurmannites*, but the two stocks are probably closely allied.

Horizon.—Infra-Valanginian (Belemnite Beds.)

Localities.—682 (2); 685 (3); 687 (3); Makerwal Colliery (1); Chichali Pass (1).

34. Subthurmannia fermori, sp. nov.

(Plate IX, figs. 1, 5; Plate X, figs. 1*a*, *b*; 7, 8.)

Diagnosis.—Subplatygyral, subleptogyral, sublatumbilicate. Whorl-section oval, with greatest thickness at lower whorl-side, narrowly arched periphery, and high and steep umbilical wall, with rounded edge. Ribbing flexuous, biconcave forwards, reclined on umbilical wall where it is very feeble, but projected laterally and especially peripherally, probably interrupted in young at siphonal groove, later continuous across periphery, with pronounced forward bend. Ribs single, bifurcating, trifurcating, bidichotomous, or quite irregular, occasionally bundled at umbilical rim into a tubercle. Suture-line (Pl. X, figs. 1*a*, *b*) complex, with deep, trifid first lateral lobe; short, trifid second lateral lobe, and three oblique auxiliary lobes (first on rim, other two on umbilical slope.).

[1] Geologia de Lima, etc., p. 51, Pl. VIII, figs. 2*a*, *b* (1907).

[2] See in Weaver, *Mem. Univ. Washington*, I, p. 461; Pl. XLVII, fig. 317; Pl. LVIII, fig. 367 (1931).

[3] Argentinische Jura-Ablagerungen, p. 37 (163); Pl. XII (XXVI), figs. 1-4 (1897).

[4] See e. g. *ibid.* Pl. XXIII (XXXVII) fig. 1; Pl. XVII (XXXI), figs. 1—5.

Measurements.

Diameter	160 mm.
Height of last whorl	36%
Thickness of last whorl	32%
Umbilicus	38%

Remarks.—The holotype of this species is entirely septate and there are even larger fragments showing suture-lines, but there is no body-chamber portion. The ribbing of these fragments differs somewhat; some are transitional to the more coarsely ribbed form described below as *S.* sp. ind., others are more finely ribbed and lead to *S. media*, sp. nov., while those with more oblique ribbing and a tendency to develop prominent primary stems of the costae are transitional to *S. transitoria* and, thence to *Raimondiceras* ? The only two fragments of inner whorls, unfortunately, are doubtful, and the larger is not well enough preserved to be figured, but the smaller (Pl. X, fig. 8) shows that the ribs are then more distantly spaced than in the other forms here described with the exception of the next two (*S.* sp. ind. and *S.* sp. ind. cf. *lorensis*) and *S.* (*Berriasella* ?) sp. ind.

The present species distantly resembles *S. boissieri* (Pictet)[1], and the Himalayan forms referred by Uhlig[2] to that form and to *Hoplites* (*Thurmannia*) nov. sp. ind. aff. *boissieri*; both the latter are probably worthy of distinct names. The resemblance to *Substeueroceras koeneni* (Steuer),[3] is also superficial; the inner whorls are different, the ribbing is more flexuous and the peripheral sinus is less acute in the Andine form. *Reineckeia incerta*, Steuer[4], however, may be more closely related, although its inner whorls (in side-view) seem rather different.

Horizon.—Infra-Valanginian (Belemnite Marls).

Localities.—687 (15, including doubtful fragments); 682 (3 doubtful fragments); 50 (1); Chichali Pass (2).

35. Subthurmannia, sp. ind.

(Plate VIII, figs. 6*a-c*.)

There are some fragments of a form less closely ribbed than *S. fermori*, but apparently connected with it by transitions. Unfortunately, the fragments (which are all septate) are rather poor and it is not certain that the smaller of the two which are here figured, belonged to the same species as the larger, and not to one of the passage-forms. It shows single and bifurcating ribs, but all the single costae unite with a bifurcating rib at the umbilical edge in a very slight tubercle. The whorl-section is regularly oval, with the thickness about three-quarters of the height, and the peripheral sinus of the costation is only slight and the siphonal band is inconspicuous. The larger fragment, which also shows the very complex suture-lines, has a more degenerate costation, with the peripheral chevrons more acute and the venter more compressed. The siphonal band in a third and similar fragment is more distinct, but, in at least one of three more fragments, the costae are continuous across the venter. They are closer, sharper, and perhaps a trifle

[1] Mélanges paléontologiques, II, p. 79; Pl. XV, figs. 1-3 (1867).
[2] Fauna of the Spiti Shales, fasc. 2, pp. 233-34; Pl. LXXX, figs. 1*a*, *b*; Pl. LXXXI, figs. 1*a*, *b* (1910).
[3] Argentinische Jura-Ablagerungen, p. 45 (171); Pl. XVII (XXXI), figs. 1-5 (1897).
[4] *Ibid.*, p. 37; Pl. XII (XXVI), figs. 1-4.

more projected in the median line than in the Fontanil example attributed by Kilian[1] to *Thurmannites thurmanni*. Conversely, another fragment has the venter unusually smooth and the ribs appear to be all single, owing to the bifurcating costae having long and low branches.

It is possible that at least one of the examples attached by Felix[2] to his *Hoplites tenochi* is related to the present form; and both the examples here figured show a similar thickening of the ribs at the umbilical edge. Since Burckhardt[3] already had considered *H. tenochi* to be nearly allied to *S. boissieri* (Pictet), the resemblance seems to be more than accidental, but, as is shown by Uhlig's[4] tentative reference of *H. tenochi* to *Berriasella* in one place and to *Neocomites* in another, the affinities of this form are by no means established. As mentioned below, there are several fragments of forms intermediate between the species here described and *S.* sp. ind. cf. *lorensis* (Lisson).

Of five fragments in the Wynne collection, four had been referred by Folgner to *Favrella*, including one new species that was given the MS. name "*thurmannoides*". But one was labelled "*Hoplites* (*Thurmannia*) ? cf. *boissieri*, Pictet and Campiche". The former has the peripheral ribbing slightly more projected and is thus probably a passage-form to *S. lissonioides*.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—682 (1); 685 (2); 687 (3); 687A (2); Chichali Nala, north limb (1); Chichali Pass (5); Baroch Gorge, No. K. 40/157 (1).

36. Subthurmannia, sp. ind. cf. lorensis (Lisson).

(Plate XII, figs. 3, 4; Plate XIII, fig. 1.)

Some fragments, three of which are here figured, show still coarser ribbing than the form last described. They are, perhaps, not identical, for the point of bifurcation does not appear to be at the same height in all, and there are differences in the general aspect of the ribbing, which, however, may be due to the mode of preservation. In the largest (unfigured) fragment, the whorl-height is 67 mm. and the thickness is 47 mm. The oval whorl-section has its greatest width just above the rounded umbilical border. The ribbing is distinctly interrupted on the rounded venter, causing a conspicuous siphonal band, if not actually a groove. The example figured in Pl. XIII, fig. 1, has a less compressed whorl-section than the other fragments and the peripheral ribbing is more continuous and less projected. This example, however, is slightly malformed, which somewhat enhances the resemblance to *S. boissieri*, already cited, or even to the very large *Thurmannites* cf. *salientinus* (*non* Sayn ?) figured by Kilian and Reboul[5]. Yet another septate example (K. 35/57) is comparable to, if not identical with the outer whorl of Uhlig's[6] large Himalayan *S. boissieri*, which, as already men-

[1] Quelques Céphalopodes nouveaux ou peu connus de la période secondaire. *Bull. Soc. statist. Isère*, 3rd ser., Vol. XVI, Pl. III (1892).

[2] Versteinerungen aus der mexicanischen Jura- und Kreide-Formation. *Palaeontographica*, Vol. XXXVII, p. 186, Pl. XXIX, fig. 1 only (1891).

[3] Faunes jurassiques et crétaciques de San Pedro del Gallo. *Bol. Inst. geol. Mexico*, No. 29, p. 227 (1912).

[4] Fauna of the Spiti Shales, fasc. 2, pp. 159 and 175 (1910).

[5] Sur la faune du Valanginien moyen du Col de Frêne (Savoie). *C. R. Assoc. Franc. Av. Sci.* Congrès de Tunis (1913), 1914, p. 2, footnote 2.

[6] *Op. cit.*, p. 233, Pl. LXXX, fig. 1*a* (1910).

tioned, deserves a separate name. All the other examples listed below are transitional to the species previously described in so far as the costation is closer and the periphery shows more or less continuous chevrons; some of them, however, are so poorly preserved or crushed that correct identification is impossible. The suture-line is apparently similar to that of the previous two species.

The comparison to *S. lorensis* (Lisson)[1] is, of course, tentative and is based on the resemblance between some of the fragments and the adult whorl-portion attached by Lisson to his species, of which fig. 4a, however, will have to be taken as type. Whether the two examples belong to the same species, is doubtful, and in the absence of a whorl-section of the larger fragment, the resemblance is confined to the irregular lateral ribbing. Of the species to which Lisson had considered his form to be related, *Hoplites mexicanus*, Aguilera[2] is distinguished by its more flexuous ribs, but apart from the absence of the lateral curve of the ribs, some of the transitional fragments listed below show a certain resemblance to the *Hoplites* sp. ? figured by Aguilera[3]. The large *Thurmannites thurmanni* (Pictet and Campiche) figured by Kilian[4] is also comparable, but the bifurcation of its ribs is rather regular, and in the same author's *Hoplites albini*[5] the primary ribs are far apart and much blunter than in the present form, at a comparable diameter, so that it probably belongs neither to *Thurmannites* nor to *Subthurmannia*.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—682 (5); 684 (1); 687 (3); 687*a* (4?); 50 (1); Baroch Nala, Malla Khel (5); N. side of Miranwal Nala, Makerwal Colliery, K. 35/791 (1 ?); Chichali Pass (1).

37. Subthurmannia (Berriasella ?) sp. ind.

(Plate X, fig. 3.)

A single fragment differs from the form figured in Pl. X, fig. 8 (and doubtfully attached to *S. fermori*) merely in having more distant costation. Most of the ribs bifurcate at or below the middle of the whorl-side, but the few single ribs unite with a branched rib at the umbilical edge. This is not a feature found in the true *Berriasella* which has the single ribs as independent as the bifurcating ribs. The whorl-section is subrectangular, with the thickness about three-quarters of the whorl-height, and with flattened sides, a subtabulate venter, with the siphonal line scarcely marked, and a comparatively high and steep umbilical wall. Only part of the suture-line is visible on the side not figured and the external saddle is rather simple.

[1] Geologia de Lima, etc., 1907, p. 36, Pl. IV, fig. 5 only. This species was provisionally referred by Burckhardt (*Bol. Inst. geol. Mexico*, No. 29, 1912, p. 132) to the genus *Kossmatia*, Uhlig, which is almost certainly incorrect.

[2] In Castillo and Aguilera: Fauna fosil de la Sierra de Catorce, San Luis Potosi. *Bol. Com. geol. Mexico*, No. 1, p. 41, Pl. XV (1895).

[3] *Ibid.*, p. 42, Pl. XVIII.

[4] *Bull. Soc. Statist. Isère*, Pls. III & IV (1892).

[5] Sur une nouvelle ammonite des calcaires de Fontanil (Isère). *C. R. Assoc. Franç. Av. Sci.*, Vol. XXVI, Congrès de St. Etienne, p. 353, Pl. I (1897).

Apart from the periphery the present example resembles the Madagascan form of *Subthurmannia* figured in Pl. XIV, figs. 3*a*, *b*. This I formerly[1] recorded as *Thurmannites* aff. *boissieri* (Pictet), and it is probably identical with *Berriasella* n. sp. ind. aff. *privasensis* (Pictet) Uhlig[2], while the same author's *B.* cf. *privasensis*[3], *Blanfordia* sp.[4], and *Thurmannia* (*Berriasella*) aff. *rarefurcata* (Pictet)[5] are scarcely distinct. The smaller fragment figured in Pl. VIII, figs. 5*a*, *b* has closer ribbing, like the Himalayan form represented in Pl. IX, figs. 2*a*, *b*, but its peripheral ribs are almost perfectly straight, not projected like those of the larger fragment. With its much more primitive ventral aspect, the form here described is thus somewhat transitional between *Berriasella* and *Subthurmannia*, but the branching of the ribs at the umbilical edge is decisive for systematic purposes. *Berriasella oppeli* (Kilian=*Ammonites callisto*, Zittel, *non* d'Orbigny) is also comparable to the form here described, but less so the true *B. callisto* (d'Orbigny) which is transitional to *Parodontoceras callistoides* (Behrendsen). Casts of the holotypes of both these species have been excellently figured by Burckhardt[6]. It is uncertain whether *Berriasella patagoniensis*, Favre[7], with at least one single and bifurcating rib, meeting at the umbilical edge, is as close to the present species as appears from a comparison of the figures; both forms are too incompletely known, though the outer whorl of the Patagonian species is quite different from anything so far found in the Salt Range.

Horizon.—Infra-Valanginian (Belemnite Beds).

Locality.—687 (1).

38. Subthurmannia transitoria, sp. nov.

(Plate XI, figs. 1*a*, *b*.)

Diagnosis.—Subplatygyral, subleptogyral, sublatumbilicate. Whorl-section elliptical, with greatest thickness at lower half of whorl-side, high and steep umbilical wall, but rounded edge, and first sulcate, later tabulate, and finally arched, periphery. Ribbing at first as in *S. fermori* or *S. media* and allies; later there is differentiation into strong primaries, spaced rather distantly, and short, projected secondaries, either emanating from the primaries or else intercalated, and meeting on siphonal area in chevrons directed forwards. Suture-line complex, as in other *Subthurmannia* here figured.

Measurements.

Diameter	(?) 160 mm.
Height of last whorl	38%
Thickness of last whorl	28%
Umbilicus	35%

[1] *Pal. Ind.*, N. S., Vol. IX, Mem. 2, pt. 6, p. 824 (footnote 2) (1933).

[2] Fauna of the Spiti Shales, fasc. 2, p. 184, Pl. XC, figs. 2*a-d* (1910).

[3] *Ibid.*, p. 183, Pl. XC, figs. 6*a*, *b*.

[4] *Ibid.*, p. 191, Pl. LXXXIV, figs. 3*a*, *b*.

[5] Fauna of the Spiti Shales, fasc. 2, 1910, p. 237, Pl. LXXXIV, fig. 4. [*Hoplites* (*Thurmannia*) in the text and *Hoplites* (*Berriasella*) in the plate].

[6] *Bol. Inst. geol. Mexico*, No. 33, p. 56; 1919, Pl. XIX, figs. 1-2 and 5-7 (1921).

[7] Die Ammoniten der unteren Kreide Patagoniens. *N. Jahrb. f. Min.*, etc. Beil. Bd., XXV. p. 622, Pl. XXXIII, fig. 5 (1908).

Remarks.—All the specimens available are septate fragments, without the inner whorls, and as the characteristic feature of the present species, namely the separation of the primary rib-stems, only appears at larger diameters, it may not be possible to distinguish the young of *S. transitoria* from species like *S. media* or *S.* sp. ind. The latter is undoubtedly its closest ally and differs merely in retaining the early bidichotomous or irregular ribbing to the end, also in having the peripheral ribs less projected. The species described below as *S.* sp. ind. aff. *transitoria* is more involute and still more extreme, having the blunt and distant primaries already at a comparatively small diameter, but both forms are interesting since they show decided resemblance to the fragments described below as *Raimondiceras ? salinarium.* The form figured in Pl. XII, fig. 1*a* (*Subthurmannia* sp. nov.?) is still more distinctly transitional, but probably only morphologically; the inner whorls are apparently quite different. For in a fragment, intermediate between the present form and *S.* sp. ind. (Pl. X, fig. 4), with just a suspicion of a second tubercle at the point of branching of two ribs, the earlier whorls are like those of *S. patella,* only with a more definitely tabulate venter. This foreshadows the ventral differentiation in the typical Neocomitidae, whereas in *Raimondiceras* the tubercles are prominent already in the young, and the leanings are towards *Acanthodiscus.*

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—687 (10, including doubtful fragments); 687*a* (1, transitional to *S.* sp. ind.); Chichali Pass (1).

39. Subthurmannia, sp. nov. aff. transitoria, sp. nov.

(Plate XI, figs. 2, 3.)

There is a form, resembling the last, in which the differentiation of the ribbing into thick and distant primary stems and projected secondaries takes place at an earlier stage. The largest fragment has the following dimensions:—

Diameter	126 mm.
Height of last whorl	44%
Thickness of last whorl	30%
Umbilicus	27%

It will be seen that this form is also more involute than *S. transitoria,* with a proportionately greater whorl-height, and the secondary ribbing is coarser than in that species. The slanting umbilical slope is unusually high and the terminations of the ribs on the edge are tuberculate, so that this form is also somewhat transitional to *S.* (Gen. nov. ?) *pseudopunctata,* sp. nov.

A smaller second fragment is more compressed, the whorl-thickness being 21 mm. where the height is 34 mm., and the venter is rather narrow. A third specimen, apparently transitional to *S. transitoria* and without umbilical nodes, shows only the primary bulges but no secondaries. This fragment shows some

resemblance to the final portion of Gabb's[1] holotype of *Amm. raimondianus*, which, judging by the change in the venter from sulcate to rounded and by the ornamentation of its inner whorls, could have been held to belong to *Subthurmannia*, if it had not been refigured by Lisson[2]. But the tuberculate *Hoplites* juv .*raimondii* (Gabb) of Lisson[3], the genotype of *Raimondiceras*, Spath, 1924, is closer to the form described below as *Subthurmannia* sp. nov. ? and to *Raimondiceras* (?) *salinarium*, sp. nov.

The present form shows some resemblance to a *Hoplites* sp. nov. from the Valanginian of Langeron figured by Baumberger[4] and considered to be quite distinct. The whorl-section of the Swiss form, however, is more bulging laterally and its venter is less rounded, while the projecting primary ribs are less blunt and shorter than those of the present form.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—685 (1); 687 (2); Chichali Pass (2).

40. Subthurmannia, sp. nov. ?

(Plate XII, figs. 1*a*, *b*.)

Several fragments, two of which are here figured, may not all belong to the same form, but they indicate the presence in the Belemnite Beds of at least one other species, resembling both *S. transitoria* and *S.* sp. nov. cf. *transitoria*. The secondary ribs are coarser and more projected than in the former species and the primary ribs, which are more distinct than in the second form cited, are almost tuberculate at both ends, which makes the fragments appear transitional to *Raimondiceras*. One of the fragments (Pl. XII, fig. 1*b*) somewhat resembles *Hoplites pseudomalbosi*, Sarasin and Schöndelmayer[5], except that the secondary ribs are very strongly projected; but judging by the earlier whorls, the Swiss species is as little related to the form here discussed, as it is to *Raimondiceras*, which, as Lisson has shown, develops almost smooth outer whorls.

Horizon.—Infra-Valanginian (Belemnite Beds).

Localities.—685 (1); 687 (6); Chichali Pass (1).

41. Subthurmannia filosa, sp. nov.

(Plate XIII, figs. 5*a-e*.)

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate. Whorl-section regularly oval, with greatest thickness at lower half of gently convex side, close to rounded umbilical border. Periphery rounded, faintly sulcate in median line, later flattened. Faint sigmoidal ribs, strongly projected near venter, but with only a slight chevron, directed forwards, on the periphery, where they are

[1] Description of a Collection of Fossils, made by Doctor Antonio Raimondi in Peru. *Jl. Acad. Nat. Sci. Philadelphia*, Vol. VIII, second series, part 3, p. 268, Pl. XXXVII, fig. 2 (1877).

[2] Los Tigillites del Salto del Fraile y algunas *Sonneratia* del Morro Solar. *Bol. Cuerpo Ingen. Minas*, Peru, No. 17, p. 44, text-fig. 23 (1904).

[3] Geologia de Lima, etc., p. 41, Pl. V, figs. 1*a*, *b* (2) (1907).

[4] *Mém. Soc. pal. Suisse*, Vol. XXXII, p. 61, Pl. XI, fig. 3 (1906).

[5] Etude monographique des Ammonites du Crétacique inférieur de Châtel-Saint-Denis. *Mém. Soc. pal. Suisse*, Vol. XXVIII, p. 79, Pl. X, figs. 1-2 (1901).

interrupted at first, but continuous across, later. Suture-line very complex, as in other species of *Subthurmannia* (Pl. XIII, figs. 5*d*, *e*).

Measurements.

	Holotype (Plate XIII, figs. 5*a*, *b*).	Plate XIII, fig. 5*d*.
Diameter	67	150 mm.
Height of last whorl	46	39%
Thickness of last whorl	33	25%
Umbilicus	27	33%

Remarks.—The holotype is small, entirely septate, and not well preserved, so that it may seem rash to base a new species on it. There can be no doubt, however, that it represents a form distinct from all the others here described; and with the aid of a number of fragments of all sizes, and the evidence of the allied species here described, it is possible to define the present form fairly accurately. One fragment, for example, retains a portion of the periphery of the inner whorls and shows a broader groove than that of the young *S. lissonioides*, figured in Pl. VIII, figs. 4*a*, *b*, with the projected terminations of the ribs prominent, as in the immature *Thurmannites thurmanni*, figured by Kilian[1]. The section given in Pl. XIII, fig. 5*c* is based on another fragmentary example which shows that the inner whorls were rounded before becoming compressed, but the large, smooth specimen figured in Pl. XIII, fig. 5*d*, with a slightly more prominent umbilical rim, is perhaps less definitely referable to the present form which is connected with *S. lissonioides* by many apparent transitions, though these are all fragmentary. There are many such whorl-portions, comparable to that figured in Pl. XIII, fig. 5*d*, and it is not certain that even those that are perfectly smooth must all belong to the form here described, although this is probable. One of the largest of these has a whorl-height of 72 mm. and a thickness of 41 mm. and still retains the characteristic oval shape, with the rounded umbilical rim. Nine such smooth fragments in the Wynne collection had been labelled by Folgner "*Favrella* sp. ind."

The present species shows resemblance to such finely ribbed forms as *Substeueroceras koeneni* (Steuer)[2] and *S. alamitosensis*, Aguilera[3], but the inner whorls are entirely different in the two stocks, and the point of branching of the ribs is much higher in *Subthurmannia*. *Amm. smielensis*, Pomel[4] has a similar whorl-section, but like the forms described below, it has more coarsely ribbed earlier whorls.

Horizon.—Infra-Valanginian, Belemnite Beds.

Localities.—687 (14, including doubtful fragments); 685 (4); Baroch Nala, Malla Khel (3); Chichali Pass (9).

[1] *Bull. Soc. Statist. Isère*, Pl. V, fig. 1 (1892).

[2] Argentinische Jura-Ablagerungen, p. 45 (171); Pl. XVII (XXXI), figs. 1-4 (1897).

[3] Fauna Fosil de la Sierra de Catorce, San Luis Potosi. *Bol. Com. geol. Mexico*, No. 1, p. 15, Pl. XIII, fig. 2 (as *Rhacophyllites*) (1895).

[4] Pal. Oranaise, No. 2, p. 44, Pl. VII, fig. 1 (1885).

42. Subthurmannia (Gen. nov. ?) pseudopunctata, sp. nov.

(Plate XIV, figs. 6*a-c*.)

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate. Whorl-section elliptical, with greatest thickness at spines on umbilical edge, high and smooth umbilical wall, and evenly arched venter, in adult. Ribs faint and irregular on whorl-side, more distinct and projected forwards near the periphery; continuous across at end, with chevrons directed forwards; smooth siphonal band at earlier stage and probably grooved in young. About nine sharp umbilical bullae to the half-whorl. Suture-line very complex, similar to that of the other species of *Subthurmannia* here figured (Plate IX, fig. 3).

Measurements.

Diameter	90 mm.
Height of last whorl	47%
Thickness of last whorl	33%
Umbilicus	21%

Remarks.—The holotype is entirely septate, as are some fragments of larger examples, one of which is here figured. Since in these, however, the umbilical tubercle is scarcely developed, if at all, and since the smooth umbilical wall is steeper and less high, they are rather doubtful and included here merely on the strength of the irregular lateral ribbing which persists after the peripheral costation has disappeared. In the similar, unornamented fragments above referred to *S. filosa*, the whorl-side is smooth before the ventral ribbing disappears and the umbilical edge is less prominent and gently rounded.

It may be added that one of these large smooth fragments had been labelled by Folgner *Leopoldia* aff. *desmoceroides* (Karakasch), but in the absence of the earlier whorls it is impossible definitely to identify the specimen. The dorsal area could not be developed but the rounded whorl-section and greater thickness seem sufficient to prevent inclusion in Karakasch's[1] species.

The present form has some resemblance to *Dalmasiceras punctatum*, Djanélidzé,[2] from the *boissieri* zone, which has been taken to be an Infra-Valanginian derivative of the Tithonian *D. dalmasi* (Pictet). The affinity, however, is probably not very close, if the inner whorls of the French form are comparable to those of the transition between *D. dalmasi* and *D. punctatum*, figured by Djanélidzé[3]. The smoothness of the umbilicus in the form here described and the unusual height of the umbilical slope also prevent comparison with *S. occitanica* (Pictet) already referred to, and forms that have been attached to this species, like *Hoplites* aff. *occitanicus* of Kilian[4]. It is possible that the *Hoplites* n. sp. ind. figured by Uhlig[5] from the Valanginian Teschen Shales is closer to the present form, and it certainly seems to agree in ornamentation and suture-line; but as

[1] *Trav. Soc. Imp. Nat. St. Pétersb.*, Vol. XXXII, p. 83, Pl. XII, fig. 1 (1907.)

[2] *Dalmasiceras*, un sous-genre nouveau du genre *Hoplites*. *Bull. Soc. géol. France* (4), Vol. XXI, p. 347, Pl. XIII, fig. 3, Pl. XIV, fig. 2 (1922).

[3] *Ibid.*, Pl. XII, fig. 5.

[4] Mission d'Andalousie, p. 666, Pl. XXXI, fig. 4 (1887).

[5] *Denkschr. k. Akad. Wiss., Wien.*, Vol. LXXII, p. 58 Pl. VIII; figs. 2*a*, *b* (1901).

it is crushed and as the inner whorls cannot be compared, it is impossible to stress the apparent affinity. The resemblance to *Neocomites* (*Calliptychoceras* ?) *pseudovicarius*, sp. nov. supports the view that the present form is more advanced than the typical species of *Subthurmannia.*

Regarding the systematic position of the form here described, it is of interest to note its resemblance to certain Tithonian fore-runners of the Neocomitidae, especially among the Berriasellid genera *Substeueroceras* and *Parodontoceras* and their more involute offshoots. For example *Odontoceras kayseri* (Steuer)[1], by developing umbilical tubercles and smoother inner whorls, could easily have passed into a form like the present. The fact that this Andine species has been subsequently referred to *Berriasella* by Uhlig,[2] to "*Thurmannia*" by Gerth[3] and to *Neocomites* by Kilian,[4] Burckhardt[5] and Krantz[6] shows its transitional position, and there is even resemblance to the somewhat aberrant *Kossmatia pseudodesmidoptycha*, Krantz.[7] Now Steuer himself already considered *O. kayseri* to be apparently close to *S. occitanica* (Pictet) which is an involute development of the *boissieri* stock. Burckhardt also put them in the same group, but since *O. kayseri* is now known to be of Upper Tithonian age, it is probable that it is merely a development of *Substeueroceras*, somewhat homoemorphous to *S. occitanica* and the present form. Since the change from Berriasellinae to *Thurmannites* (*sensu lato*) did not take place in a single line but in the broad stream of development, I am not, in the present state of our knowledge, prepared to create new genera for these intermediate types, although *S. boissieri*, *S. filosa* and *S. pseudopunctata* are apparently widely distinct.

Horizon.—Neocomian (Belemnite Beds).

Locality.—687 (5).

INCERTAE SEDIS.

Genus: RAIMONDICERAS, Spath, 1924.

43. RAIMONDICERAS (?) SALINARIUM, sp. nov.

(Plate XIV, figs. 4, 5.)

Diagnosis.—Subplatygyral, subleptogyral, sublatumbilicate. Whorl-section rounded, slightly higher than wide, with greatest thickness above rounded umbilical wall. Comparatively high and steep umbilical wall and slightly flattened, almost evenly arched, venter, in adult, but distinct groove at earlier stages. Ribs numerous, strongly curved forwards on side and especially ventrally. Some are thickened and develop tubercles at umbilical edge and at

[1] Argentinische Jura-Ablagerungen, p. 48 (174), Pl. XXII (XXXVI) figs. 6-8 (1897).
[2] *Denkschr. k. Akad. Wien.*, Wien, Vol. 85, p. 72 (1910).
[3] Fauna und Gliederung des Neocoms in der argentinischen Kordillere. *Centralbl. f. Min., etc.*, p. 116 (1921).
[4] Lethaea geognostica, fasc. 2, p. 187 (1910). The identification of *S. occitanica* with *Aulacostephanus anglicus* (Steuer) is, of course, quite inadmissible.
[5] *Bol. Inst. geol. Mexico*, No. 29 p. 163 (1912).
[6] *Steinmann Festschrift*, p. 447 (1926).
[7] *Ibid.*, p. 448, Pl. XVI, figs. 1-2.

point of branching into two or three secondaries; intervening two unbranched ribs remain thin. In young all the secondary ribs come to an abrupt stop each side of the ventral groove; later they are continuous across periphery with an obtuse chevron directed forwards. Suture-line not very complex, incompletely known.

Measurements.

Diameter	(?)	90 mm.
Height of last whorl		37%
Thickness of last whorl		33%
Umbilicus		36%

Remarks.—The measurements are approximate since the three (septate) fragments available are very incomplete, but there can be no doubt that the present is a distinct species, even if it has not been possible to expose much of the suture-line. The genotype of *Raimondiceras*, namely *R. raimondianum* (Gabb) as represented by "*Hoplites* juv. *raimondii*", Gabb sp. in Lisson[1], has less close ribbing and more projected ventral chevrons, but both periphery and ornamentation are variable in *Raimondiceras* which I originally (on the evidence of some South American specimens in the British Museum) took to include what was subsequently separated as *Pfluckeria*, Lisson (later in 1924)[2] and *Lissonia*, Gerth[3] (1926). Only since the little-known forms of this group may be partly of higher Valanginian age, *R. salinarium* is to be regarded as an early type, connecting *Raimondiceras* with forms of *Subthurmannia* like *S.* sp. nov. ? or *S. transitoria*, sp. nov. (p. 57). It must be mentioned, however, that acanthodiscid forms like "*Holcostephanus*" (*Spiticeras*) spec. aff. *conservans*, Uhlig, Welter[4], described as Tithonian, but possibly of Infra-Valanginian age, also may have produced *Raimondiceras*-like offshoots. It does not thus seem that the existence of apparent transitions to the forms of *Subthurmannia* just mentioned, signifies more than that there is no fundamental difference between the tuberculate and costate offshoots of Berriasellidae, although this difference is stressed for systematic reasons. That is to say, *Raimondiceras*, unless restricted to the "*Sonneratia*" described by Lisson, is as polyphyletic as the other genera here described.

It should be added that in the smallest of the three fragments the outer tubercle is very strongly developed and more prominent than the inner which is characteristic of the [Colombian] forms figured, for comparison, in Pl. XV, figs. 3*a-c* and 4 and Pl. XVI, figs. 7 *a*, *b*, or of *R. gerthi* (Weaver)[5], which has even been mistaken for a *Spiticeras* (or *Himalayites*). In those tuberculate passage-forms between *Protacanthodiscus* and *Neocosmoceras* (*hookeri* group) that have a somewhat similar lateral ornament, the periphery is quite different, and the

[1] Geologia de Lima, 1907, p. 41, Pl. V, figs. 1*a*, *b* (2). See also *loc. cit.* (*Bol. Cuerpo Ingen. Minas, Peru*, No. 17), pp. 46-58 (as *Sonneratia*).

[2] Edad de los Fosiles Peruenos, etc., 3rd ed. (1924), pp. 57-8. My *Raimondiceras* dates from February 1st, 1924, but Lisson's bibliography (p. 200) contains a reference dated March, 1924.

[3] *Actas Acad. Nac. Cienc. Cordoba*, Vol. IX, p. 111 (1925).

[4] Eine Tithon-Fauna aus Nord-Peru. *N. Jahrb. f. Min., etc.* (i), p. 32, Pl. V, fig. 1-2 (1913).

[5] *Mem. Univ. Washington*, Vol. I, p. 428, Pl. XLVII, figs. 315-16 (1931).

saddles are long and slender instead of short and wide. In the true *Acanthodiscus*, which also includes forms similar in lateral view to *Raimondiceras* (*e.g.*, *A. radiatus*, Bruguiére sp., var. *stenonotus*, Baumberger[1]) or *Neocomites houdardi*, Roman[2] the wide and flat periphery is the most characteristic feature.

Horizon.—Neocomian (Belemnite Beds).

Locality.—687 (3).

Sub-Family : *HIMALAYITINAE*, Spath.

Genus : HIMALAYITES (Uhlig MS.) Boehm, 1904

44. HIMALAYITES cf. SEIDELI (Oppel).

(Plate V, fig. 8 ; Plate XII, figs. 6*a*, *b*.)

1865. *Ammonites seideli*, Oppel : Ostindische Fossilreste. *Pal. Mitteil.*, Pt. IV, p. 283, Pl. LXXX, figs. 3*a*, *b*.

1910. *Himalayites seideli* (Oppel) Uhlig ; *Op. cit.* (Fauna of the Spiti Shales), fasc. 2, p. 140, Pl. XXXIX, fig. 2, Pl. XL, fig. 1.

The poorly preserved internal cast figured in Pl. V, fig. 8, is entirely septate and shows enough of the suture-line to support the comparison to Oppel's species, based on agreement in ornamentation and whorl-shape. The latter is exactly the same as that of Uhlig's two examples, but on account of its smaller size, the Salt Range specimen has the ventral groove more distinctly developed. The ornamentation is very irregular ; the first rib seen has a very prominent lateral tubercle, with the characteristic double stem and three peripheral branches. The next rib is single but also tuberculate, and it is followed by a strongly tuberculate, triplicate rib. A similar triplicate rib, with single primary stem, follows, after a single rib without a tubercle ; and it is succeeded again by a single and a biplicate rib. The final six or seven ribs cannot be clearly traced, but at least one has the characteristic triplication. The dimensions of the specimen are :—

Diameter	34 mm.
Height of last whorl	38%
Thickness of last whorl	47%
Umbilicus	35%

Since the inner whorls are not preserved and since the example is not large enough to have developed the numerous secondaries characteristic of *H. stoliczkai*, Uhlig,[3] definite identification of the present form with *H. seideli* rather than *H. stoliczkai*, or, indeed, any other of the essentially similar species of *Himalayites*, is impossible. Unlike the more doubtful form described below as *Himalayites* (?) sp. ind., however, the present form is undoubtedly a typical member of this genus[4],

[1] *Mém. Soc. pal. Suisse*, Vol. XXXIII, p. 19, Pl. XVI, fig. 4 (1906).

[2] Sur quelques formes de Céphalopodes de l'Hauterivien de l'Yonne et des regions voisines. *Trav. Lab. Géol. Lyon*, Fasc. XXII, mém. No. 19, p. 16, Pl. I, figs. 1-3 (1933).

[3] Fauna of the Spiti Shales, fasc. 2, p. 146, Pl. XXXVIII, fig. 1 (1910).

[4] The genus *Himalayites* (Uhlig MS.) was established by G. Boehm (*loc. cit.*, Palaeontogr. Suppl. IV, 1904, p. 38) apparently for " the group of *Hoplites cortazari*, Kilian " (see Sayn, Revue critique, etc., Vol. IX, 1905, p. 42) which species thus becon es the genotype, although Dacqué (in Gürich, Leitfossilien, VII, 2, 1934, Wirbellose des Jura, p. 370) listed *Amm. seideli*, Oppel, and *H. ventricosus*, Uhlig, as types.

and it is close enough to the Tithonian example of *Himalayites* sp. figured by Besairie[1] to suggest derivation from an earlier deposit.

The small fragment figured in Pl. XII, figs. 6*a*, *b*, on the figured side shows one tubercle giving rise to four secondary ribs, but the corresponding four ribs of the opposite side—symmetrical on each side of the siphonal groove—unite (in two pairs) in two tubercles, each of which has its own primary stem. The preceding rib is single on both sides, but the succeeding costae are different again on the two sides, so that the importance of differences in costation in the various species of *Himalayites* must not be over-rated. *H. cortazari*, Kilian, the genotype, seems to differ only in having stronger lateral tubercles.

Horizon.—Tithonian or Neocomian ? (Base ? of Belemnite Beds).

Localities.—687 (1) ; 768 (1).

45, Himalayites (?) sp. ind.

(Plate V, figs. 7*a*, *b*.)

The whorl-fragment here figured retains, on its ventral side, the impression of the dorsal lobes of the next outer whorl, so that it must have belonged to a large ammonite. The suture-line itself cannot be traced clearly enough to be figured, so the only diagnostic characters to be relied on are the whorl-section and the ribbing. The former is subhexagonal, with the greatest thickness at the lateral tubercle, but a more or less pronounced ventro-lateral edge. The wide periphery is sulcate in the siphonal line and biconvex. The high umbilical slope is rounded at first but becomes perpendicular as it terminates at the umbilical suture. The ribs are inclined forwards, single or bifurcating, apparently irregular, and the point of bifurcation is strongly tuberculate, as in *Himalayites*, not merely spinous, as in the forms here attached to *Blanfordiceras*. The lateral tubercles are below the middle of the side.

While the whorl-section agrees more with that of *H. hoplitiforme*, Uhlig,[2] (1910, *non* Djanélidzé, 1922), the ornamentation is rather that of the typical forms of the group of *H. hyphasis* (Blanford)[3], in which trifurcation is rare. "*Peltoceras*" *cortazari*, Kilian,[4] which was later included by Kilian[5] himself in *Himalayites*, differs both in whorl-section and in having triplicate ribs already at a smaller diameter. Some large forms recorded by G. Boehm[6] from the Dutch East Indies, referred to *Hoplites*, but transitional between *Himalayites* and *Blanfordiceras*, are also closely comparable to the Salt Range form. Specific identification, however, is impossible and in the absence of inner and outer whorls even the reference to the genus *Himalayites* is doubtful.

[1] *Mém. Acad. Malgache*, fasc. XXI, p. 137, Pl. XI, fig. 16 (1936).

[2] Fauna of the Spiti Shales, fasc. 2, p. 151 ; Pl. XLII, figs. 2*a-c* (1910).

[3] See *ibid.*, *e.g.* Pl. XXXVIII.

[4] Mission d'Andalousie p. 674 ; Pl. XXXIII, figs. 1-3 (1889).

[5] Lethaea geognostica, fasc. 2, p. 175 (1910).

[6] Grenzschichten zwischen Jura und Kreide. Beitr. z. Geol. v. Niederl. Indien. I, 1. *Palaeontogr.* Suppl. IV, *e.g.*, Pl. III, fig. 5 ; Pl. VII, fig. 1 (1904).

Horizon.—Tithonian or Infra-Valanginian ? (base ? of Belemnite Beds).
Locality.—682 (1).

46. Himalayites ? (Gen. nov. ?) sp. ind.

(Plate VII, figs. 1*a-c*.)

There is a single example of this form and it is not only poorly preserved and does not show the inner whorls, but it is also malformed so that it is impossible to appraise its real affinities. But it is of interest beause it combines a lateral aspect reminiscent of the group of *Himalayites hyphasis* (Blanford) [1] with the peripherally projected costation of *Kilianella, e.g., K. pexiptycha* or *K. leptosoma,* Uhlig.[2] The dimensions of the specimen are as follows :—

Diameter	63 mm.
Height of last whorl	36%
Thickness of last whorl	45%
Umbilicus	39%

The whorl-section is hexagonal, as in typical *Himalayites*, and the greatest thickness is at the lateral tubercle ; the ventral groove is broad but not deep. The ribs are sigmoidal, single, bifurcating and trifurcating, but before they reach the peripheral sulcus they terminate in a forward sweep which prevents comparison of this form with the typical *Himalayites*. After the injury, about a quarter of a whorl from the end (still septate), the malformed side is slightly lower than the other, and the periphery thus is asymmetrical ; but the ventral aspect remained essentially the same as before the injury. The suture-lines are not clearly visible.

The slight thickening of the ribs on the periphery suggests affinity with *Acanthodiscus hookeri* (Blanford) and its allies[3] ; and actual comparison of the Salt Range form with Blanford's types in the British Museum showed a striking resemblance, but only in the peripheral aspect. For not only is there no real inner tubercle, but the primary ribs remain separate and of equal strength, at least before the malformed portion. Another form of somewhat similar peripheral aspect was described by Uhlig[4] as *Hoplites* (*Acanthodiscus*) aff. *michaelis*, but this has a much higher whorl, with flattened sides ; and if the comparison to the Carpathian type of Uhlig's species is correct, it can have no connection with the form here described. It is thus probable that the latter belongs to some unnamed group, transitional between *Himalayites* and "*Acanthodiscus*" (*Neocosmoceras*), but it is impossible in the absence of more favourably preserved material to discuss the exact position of this group.

Horizon.—Neocomian ? (Belemnite Beds). Derivation is less probable than in the case of the last two species.

Locality.—682 (1).

[1] See in Uhlig, Fauna of the Spiti Shales, fasc. 2 ; Pl. XXXVIII, figs. 2-3 (1910).
[2] *Ibid.* ; Pl. LXXXII, figs. 2*c*, 3*b*.
[3] See *ibid.* ; Pl. XXV, figs. 2*c*, 3*b*.
[4] Fauna of the Spiti Shales, fasc. 2, p. 223 ; Pl. XXXI, figs. 2*a*, *b* (1910).

Genus : PROTACANTHODISCUS, Spath, 1924.

47. PROTACANTHODISCUS ? sp. ind.

(Plate VI, figs. 3*a-d*.)

There are four fragments, referred to this form, but they are all small and may not belong to the same species; they agree in having prominent, tuberculated terminations of the ribs on the venter, but they differ slightly in the arrangement of the tubercles. Thus, in the figured example, every rib, whether single, bifurcating, or fibulate, has a peripheral tubercle, but they are of different sizes, without any regularity. In the other examples the difference between the tuberculated ribs (every third or fourth) and the intervening costae is more marked, but the ribbing is essentially of the same style. The ventral groove is deep and pronounced already at a very small diameter, when the rounded or depressed whorls resembled those of a young *Blanfordiceras* or *Himalayites*. The later volutions are compressed; in the figured fragmentary example the whorl-height is 8 mm. and the thickness 6·5 mm.

All the fragments are septate and one shows the suture-line. This is much like that of the forms of *Blanfordiceras*, here figured (Pl. VI, fig. 14*c*), with the trifid first lateral lobe slightly deeper than the external lobe and with small and oblique second lateral and (two) auxiliary lobes. The suture-line, thus, is comparable to that of "*Acanthodiscus*" *hookeri* (Blanford)[1], except that the three prongs of the principal lobe are more sharply defined; but it is rather different from that of *Neocosmoceras* ("*Octagoniceras*") *octagonum* (Strachey MS.) Blanford sp.[2]

Although the present form does not look much like that described below as *Neocosmoceras* sp. nov., it represents a stage in ornamentation passed through by the latter before the lateral tubercle appears. One of the fragments indeed, shows a distinct tubercle at the point of branching (by bifurcation or fibulation) of the ribs, but in the other three examples the point is only just prominent enough to be seen in the transverse section, as in Uhlig's fig. 4*c* (Pl. XXVII). *Blanfordiceras* aff. *wallichi* (Blanford), described above, lacks the peripheral tuberculation, but in side-view is not unlike those fragments that show only single and bifurcating ribs.

It is possible that the ammonite figured by Lemoine[3] as *Hoplites* (*Acanthodiscus*) *andreaei* (*non* Kilian), from Madagascar, has inner whorls like the form here described, but comparison with the young of such species of *Protacanthodiscus* as have been described by Pomel[4] from Lamoricière in Algeria (as *Amm. pouyannei*, Pomel, *A. euthymi* and *A. malbosi*, Pictet) is still more difficult. Judging by Uhlig's remarks on the inner whorls of his various groups of "*Acanthodiscus*" and by the Himalayan material before me, the Spiti Shales forms also are not closely comparable to the ammonite here described.

[1] See Uhlig, Fauna of the Spiti Shales, fasc. 2; Pl. XXV, fig. 2*d* (1910).

[2] *Ibid.*; Pl. XXVII, fig. 3*e*.

[3] Études géologiques dans le Nord de Madagascar. Ann. Hébert. III, p. 178; Pl. I, figs. 1, 1*a* (1906).

[4] Céphalopodes néocomiens de Lamoricière. *Mat. Carte géol. Algérie* (I), Pal. No. 2, p. 59; Pl. III, Pl. IV, figs. 1-4; Pl. V, figs. 1-3 (1889).

The fragments so far discussed seem to be identical with the earlier part of the outer whorl of the larger example figured in Pl. VI, figs. 1*a*, *b*. This is septate almost to the end, shows the suture-lines, which agree with those above described, and it has the characteristic peripheral tuberculation of some of the ribs, beginning with an isolated, fibulate pair. On the last half whorl only three or four of the bifurcating ribs have the rear branch tuberculate on the periphery, but the lateral tubercle becomes less conspicuous and the alternation of single and bifurcating ribs is that of a *Blanfordiceras*. The point of bifurcation of the ribs in this complete example is higher than in the fragment figured in Pl. VI, fig. 3, which is from another assemblage and in a different mode of preservation (limonite, not a glauconitic marl); another of the limonitic fragments, however, has the point of bifurcation quite as high as the larger specimen.

This latter is of interest because in the somewhat similar *Berriasella privasensis* (Pictet)[1], the young may sometimes show a rudimentary tubercle at the point of bifurcation of the ribs, so that Pictet thought the affinities of his species to be rather with *Amm. asperrimus*, d'Orbigny[2] than with *Amm. calisto*, d'Orbigny, a form which I refer to *Parodontoceras*. *Amm. asperrimus*, however, which may be a *Kilianella*,[3] has nothing to do with the form here discussed. The peripheral tubercles also are against reference to *Berriasella* or *Micracanthoceras*, but the young of *Corongoceras köllikeri* (Oppel)[4] is somewhat similar. It is possible, thus, that the present form is closer to *C. mendozanum* (Behrendsen)[5], than to *Protacanthodiscus*, but it is necessary to await the discovery of more material before definitely referring it to that genus, in view of the occurrence of fibulate ribs.

Horizon.—Tithonian ? (base ? of Belemnite Beds).

Localities.—678 ? (1); 680 (4); 687 (2).

Genus : NEOCOSMOCERAS, Blanchet, 1922.

(="OCTAGONICERAS", Spath, 1924.)

48. NEOCOSMOCERAS sp. nov.

(Plate VI, figs. 4*a-d*; Plate VII, figs. 4*a-d*; Plate XVIII, figs. 4*a*, *b*.)

The smallest of the three examples here figured, though incomplete, is in a good state of preservation, and it shows the innermost whorls which are greatly depressed and, first, smooth and, then, very obliquely ribbed. At a diameter of 4 mm. at which the ribbing, first distantly spaced and then closer, has already been developed for a whole whorl, the thickness is 3 mm. or 75 per cent. At 8·5 mm. diameter, the thickness is reduced to 4·5 mm. or 53 per cent. and the whorl-shape is that of the young *Himalayites stoliczkai*, Uhlig.[6] The peripheral

[1] Mélanges paléontologiques, II. 1867, p. 84; Pl. XVIII, fig. 1. Since fig. 2 was specially described as a variety it cannot be selected as the type of the species and the name *picteti*, Jacob, given to fig. 1 is invalid.

[2] Pal. Française, Terr. Crét., Vol. I, p. 206; Pl. LX, figs. 4-6 (1841).

[3] See in Kilian, Lethaea geognostica, fasc. 2, p. 193, 1910; also Uhlig (Fauna of the Spiti Shales, fasc. 2), p. 169 (1910).

[4] See in Zittel. Stramberger Schichten, p. 95; Pl. XVIII, figs. 2*a*, *b* (1868).

[5] Zur Geologie des Ostabhanges der argentinischen Cordillere. *Zeit. D. Geol. Ges.*, Vol. XLIII, p. 399; Pl. XXV, figs. 2*a* (1891).

[6] *Op. cit.*; Fauna of the Spiti Shales, fasc. 2, Pl. XXXVIII, fig. 1 (1910).

aspect, showing a deep siphonal groove, is that of the young *Himalayites* n. sp. ind., figured by Uhlig[1], but the spines at the point of bifurcation of some of the ribs (which are now more radial) are not nearly so prominent. At a diameter of only 10 mm. the ornamentation already begins to change. The originally slight peripheral thickening of some of the ribs (as illustrated in Uhlig's fig. 5*b*) becomes so pronounced that eventually large, rounded tubercles are formed, and since the intervening ribs may almost completely disappear, the pairs of tubercles are rather distantly spaced along the deeply sulcate periphery. At the same time the ribs that bear the outer tubercles develop a lateral spine, placed just above the middle of the whorl-side and the (peripherally compressed) whorl-section is octagonal. The dimensions of the complete example are :—

Diameter	19 mm.
Height of last whorl	33%
Thickness of last whorl	33%
Umbilicus	44%

There are some irregularities in the ornamentation and slight differences between the two smaller examples. Thus in the smallest specimen, two primary ribs with lateral nodes meet in one outer tubercle ; and another rib has a double or fibulate (button and loop) outer branch (between the two tubercles), while a third bifurcates at the lateral tubercle and (at the ventro-lateral edge) ends in two tubercles which are much smaller than the two preceding pairs. The second specimen retains more distinct traces of the intercalated secondary ribs, but they are very irregular, and only some are thickened where they end at the ventral sulcus. The suture-line is not clearly visible, but the smallest, fragmentary example, at any rate, is entirely septate.

The largest fragment figured in Pl. XVIII, fig. 4 is still completely septate and shows only a single pair of peripheral nodes on the last whorl, with very slight lateral tubercles on some of the ribs. But on the penultimate whorl the ornamentation is that of the smaller examples, so far as can be seen. The whorl-section, however, is then slightly wider than high, and it is only on the outer volution that height and thickness become equal. In this respect, thus, the largest fragment is somewhat transitional to the form described below as *N.* sp. ind. cf. *sayni* (Simionescu). The parallel sides of the deep and narrow external lobe just fit into the ventral groove ; the wide and large, but simple, external saddle is bifid, with the outer branch slightly higher than the inner, and the second lateral lobe and the auxiliaries are oblique and dependent (towards the umbilical suture).

While the peripheral aspect of the whorls at one stage resembles that of *N. octagonum* (Strachey MS.) Blanford sp.,[2] the inner whorls are more closely comparable to those of *N. hundesianum* (Uhlig),[3] but in both these species there is a strongly developed third tubercle already at a small diameter. This suggests comparison of the Salt Range form to *Protacanthodiscus*, e.g., *P. andreaei* (Kilian),[4]

[1] Fauna of the Spiti Shales, fasc. 2, p. 150, Pl. XXXVIII, fig. 5 (1910).

[2] See Uhlig, Fauna of the Spiti Shales, fasc. 2, p. 204, Pl. XXVII, fig. 3*b* (1910).

[3] *Ibid.*, p. 211, Pl. XXII, figs. 2*c*, 2*e*.

[4] Mission d'Andalousie, p. 670, pl. XXXII, figs. 1*a*, *b* (1889). See also Pervinquière. Pal. Tunisienne, p. 38, Pl. II, figs. 12*a*. *b* (var. *punica*) (1907).

of which the former might be held to be a strongly accelerated development. *P. andreaei* may not be as close to the Infra-Valanginian *P. malbosi* and *P. euthymi* (Pictet) as its author thought; and the inner whorls of the examples before me (from La Cisterne, near La Cadière, Garde, L. R. Cox Coll.) are not comparable to the Salt Range form here described. In fact it is just the berriasellid aspect of the earlier volutions of *Protacanthodiscus* that prompted separation from "*Octagoniceras*" and inclusion in a different sub-family; but transitional forms like *N. malbosiforme* (Steuer)[1] show that the earlier *Protacanthodiscus* is probably an indirect ancestor of the specialised and later *Neocosmoceras*.

Hoplites rerollei, Paquier,[2] a syntype of *Neocosmoceras*, may also be related to the present form, but it is difficult to compare from the figure. The superficially similar forms of the Upper Valanginian and Lower Hauterivian described as *Acanthodiscus* (from Speeton, beds C_{3-11})[3] are small examples of the group of *A. lamberti*, Sayn,[4] and their peripheral aspect is entirely different.

Horizon.—Tithonian (base ? of Belemnite Beds).

Localities.—680 (2); 768 (1).

49. Neocosmoceras, sp. ind. cf. *Sayni* (Simionescu).

(Plate VII, figs. 3*a-d*.)

This form, represented only by one half of a specimen of 17 mm. diameter, is closely allied to that last described, but it has a more inflated whorl-section. The latter, in fact, is similar to that of a young *Himalayites*, figured by Uhlig,[5] but the two ventral tubercles are much more projecting and tend to be clavate rather than bullate, *i.e.*, they are elongated longitudinally rather than transversely, although only one tubercle, and on one side only, shows this in a very marked degree. The inner whorl is ribbed, as in young *Himalayites*, and its dorsal area is perfectly smooth, so that at a diameter of about 3·5 mm. the ventral area at least must have been devoid of all ornamentation. On the outer whorl the ribs are very irregular, mostly strong, and fibulate between the lateral and ventral tubercles, but with long or short, plain or slightly tuberculate, thinner ribs in between. The ventral groove is very distinct. The specimen is entirely septate, but the suture-lines are not visible.

As in the case of the form last described, it is possible that the present example may turn out to be the inner whorls of a species like *N. sayni* (Simionescu)[6] the lectotype of *Neocosmoceras*; but even if the absence of the third or umbilical row of tubercles be held to be due merely to the smallness of the specimen, it must be admitted that the inner whorls of a form like *N. octagonoides* (Uhlig)[7] are entirely different. It may be added that Uhlig already, in his description of

[1] Argentinische Jura-Ablagerungen, p. 59 (185), Pl. IV (XVIII), figs. 1-4 (1897).

[2] Recherches géologiques dans le Diois et les Baronnies orientales. Append. paléontol., *Trav. Lab. géol. Grenoble*, Vol. V, p. iii, Pl. VII, fig. 3 (1901).

[3] Spath: Ammonites of the Speeton Clay and Sub-divisions of the Neocomian. *Geol. Mag.*, Vol. LXI, p. 76 (1924).

[4] *Mém. Soc. géol. France*, Pal., Vol. XV, p. 39, Pl. IV, fig. 11 (1907).

[5] Fauna of the Spiti Shales, fasc. 2, p. 150, Pl. XXXVIII, figs. 5*a-c* (1910).

[6] Note sur quelques Ammonites du neocomien français. *Trav. Lab. géol. Grenoble*, Vol. V, p. 6 Pl. I, figs. 7, 8 (1900).

[7] Fauna of the Spiti Shales, fasc. 2, p. 207, Pl. XXVII, figs. 1*a*, *b* (1910).

the young and somewhat doubtful *Himalayites*, cited above, noted its resemblance to what he called *Hoplites*; having entirely different opinions as regards the development of ammonites in general and the significane of the "*Parkinsonia* stage" in *Himalayites* in particular, I cannot view the apparently wide systematic gap between *Blanfordiceras* and *Himalayites* as anything but artificial and due merely to the inadequacy of palaeontological nomenclature.

The fragmentary *Himalayites* ? sp. figured by Besairie[1] and described as intermediate to *Protacanthodiscus* may be even closer to the present form than *N. sayni*, but it differs in details of ornamentation. In any case the Madagascan example supports the reference to the Tithonian rather than the Infra-Valanginian.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (1).

50. Neocosmoceras hoplophorum (Folgner MS.) sp. nov.

(Plate XXI, figs. 1*a*, *b*.)

Diagnosis.—Subplatygyral, subpachygyral, subangustumbilicate. Whorl-section octagonal, with greatest thickness at lateral tubercle and flat periphery, appearing sulcate on account of bordering rows of ventral tubercles. Ribs strong and trituberculate, umbilical row being the feeblest. Occasional splitting up of ribs into finer branches. Outer tubercles elongated at right angles to radial line. Lateral (septate ?) tubercles with large flat bases on cast. Suture-line with high external lobe and very large, trifid first lateral lobe, comparatively small first lateral saddle and very short and small second lateral lobe, followed by a very small second lateral saddle close to the umbilical suture.

Measurements (*approximate*).

Diameter	120 mm.
Height of last whorl	37%
Thickness of last whorl	38%
Umbilicus	33%

Remarks.—Folgner stated that this new form (described as *Acanthodiscus* under two different MS. names) differed from *N. octagonum* (Strachey MS.) Blanford sp. in its greater thickness, a slighter development of the inner tubercles, the lower position of the lateral tubercles and their greater strength, also in the more radial course of the ribs and in the suture-line. The holotype of *N. octagonum* is before me (B. M. no. C. 5032)[2] and I can confirm all these differences to which I would add the umbilical slope. This is comparatively smooth in Strachey's species and almost free of ribs, with only slight prolongations of the bullate umbilical tubercles, whereas in *N. hoplophorum* the very strong ribs begin at the umbilical suture. Like *N. octagonoides* (Uhlig)[3], *N. octagonum* also has the peripheral tubercles elongated radially while they are transverse in *N.*

[1] *Mém. Acad. Malgache*, fasc. XXI, p. 137, Pl. XI, fig. 23 (1936).

[2] See G. C. Crick: The Cephalopoda in the Strachey Collection from the Himalaya. I. *Geol. Mag.* N. S. Dec. V, Vol. I, p. 116 (1904).

[3] Fauna of the Spiti Shales, fasc. 2, p. 207, Pl. XXVII, figs. 1-2 (1910).

hoplophorum. The absence of the inner whorls unfortunately prevents comparison with the two species described above as *N.* sp. nov. and *N.* sp. ind. cf. *sayni* (Simionescu), but there can be no doubt that the present form is still a member of the *octagonum* group, even if developing along distinct lines. All the differences enumerated above may have a time significance and may indicate a slightly later age of *N. hoplophorum* as compared with the Spiti Shales species. Yet unlike the ornamentation of the forms of the *hookeri* group which are transitional to the true *Acanthodiscus*, the features noted in *N. hoplophorum* are not such as foreshadow the *radiatus* group of the Lower Hauterivian. Judging by the doubtful fragment described below as *N.* ? sp. ind., and also still septate, these large forms of *Neocosmoceras* belong to a type unknown outside the Salt Range.

Horizon.—Neocomian ? (Belemnite Beds). In Folgner's MS. notes the remark is added "below *Amm. astieri*", in English, and therefore probably copied from an original (Wynne) label.

Locality.—Chichali Pass (1).

51. Neocosmoceras ? ("Acanthodiscus") sp. ind.

(Plate XVI, figs. 9*a-c*.)

The only fragment available is small and poorly preserved, but it deserves special mention because it is entirely different from all the other forms here discussed. The whorl-section here reproduced is restored and perhaps slightly diagrammatic, but, although the lower part of the whorl is incomplete and the unfigured side is encrusted, the section is probably wrong only in having been taken on the slant, so that it is not round or inflated enough. This section resembles that of *Hoplites hoheneggeri*, Uhlig,[1] a species which was subsequently referred to *Acanthodiscus*, but this is even more compressed. The ribs, so far as can be seen, are more blunt than in Uhligs'[1] species and one of them shows a distinct thickening towards the ventral termination. The siphonal zone is smooth and distincly sulcate, but the rounded, bulging, umbilical wall is only incompletely exposed.

The suture-line fortunately is visible in portions and is seen to have a plump external saddle, a wide and deep first lateral lobe, with slightly unequal leaflets, and a comparatively small first lateral saddle. The arrangement is not unlike that of the comparatively simple suture-line of the restricted *Acanthodiscus*, but the sulcate periphery is entirely against comparison with forms of that genus.

I do not know of any ammonite except perhaps "*A.*" *hoheneggeri*, just cited, with which the present fragment could be brought into comparison. Forms of *Distoloceras* do not have the peripheral nodes placed radially; and since the specimen is still septate where the whorl-height is about 56 mm. it must have belonged to a form much larger than the average *Kilianella*. None of the genera of Neocomitidae, in fact, seems appropriate except *Acanthodiscus* (*sensu lato*) including the forms (*Protacanthodiscus*) to which *A. hoheneggeri* had been com-

[1] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 40, Pl. VIII, figs. 1*a-c* (1907).

pared; but the present form may well turn out to belong to an entirely new genus.

After the above was written I received the form last described as *N. hoplophorum* and I could see at once that the present form might represent a later stage of a similar "*Acanthodiscus*". One large but flat lateral boss is still visible, but the umbilical tubercle is missing even on the last two ribs of *N. hoplophorum* so that its absence in the small fragment here discussed is of no significance. The whorl-section also may have been as wide as it is high so that the resemblance to *A. hoheneggeri*, mentioned above, is really confined to the sulcate periphery in the sectional outline. It is not probable that the fragment represents the same species as *N. hoplophorum*, for the bullate ventral tubercles are too inconspicuous to have been very strong at an earlier stage; but since there is a lack of comparable large forms of *Neocosmoceras* and allies, such as *Acanthodiscus* of the type of *A. wallrathi*, Baumberger,[1] the identification of the present form must remain doubtful.

Horizon.—Neocomian ? (Belemnite Beds).

Locality.—687 (1).

INCERTAE SEDIS.

52. Gen. nov. (NEOCOSMOCERAS ?) sp. ind.

(Plate VII, figs. 2*a-d.*)

The single example available is complete, but unfortunately very small; and in the absence of suture-lines it is impossible to state whether it includes the body-chamber. The ammonite represents a different type again from that referred to last, under *Neocosmoceras*, and that described as *Blanfordiceras*. For while the young is not unlike *B. acuticosta*, the last bifurcating rib occurs where the diameter is only 8 mm., and almost the whole of the outer whorl has single ribs which are slightly inclined forwards. They each have a sharp lateral tubercle at the point of greatest whorl-thickness, and they end on each side of the deep ventral groove with a prominent, bullate, outer tubercle. This development of an outer tubercle alone prevents comparison of the present form with *Blanfordiceras*, which, moreover, tends to complicate rather than simplify its ribbing. *Neocosmoceras*, on the other hand, has single, tuberculate ribs, although according to Uhlig[2], *N. octagonum* (Strachey MS.) Blanford sp., itself, has a slight umbilical swelling already at 6 mm. diameter and a distinct inner tubercle long before it reaches the size of the present form (15 mm.).

The whorl-section is slightly wider than high and the peripheral aspect is that of the adult *N. octagonum* rather than the young,[3] and quite different from that of the *subradiatus* group of Uhlig or of the true *Acanthodiscus radiatus* (Bruguière). In spite, however, of the fact that it has only lateral and outer tubercles, *Protacanthodiscus* is even less closely comparable to the form here discussed

[1] *Abh. Schweiz. Pal. Ges.*, Vol. XXXIII, p. 22, Pl. XV, figs. 2*a*, *b* (1906).
[2] Fauna of the Spiti Shales, fasc. 2, p. 204 (1910).
[3] See *ibid.*, Pl. XXVII, figs. 3*b* and 1*b*.

than is *Neocosmoceras*; and it is thus probable that the ammonite represents a new genus which at present cannot be named, being known only in one small and incomplete example.

Horizon.—Tithonian (base ? of Belemnite Beds).

Locality.—680 (1).

Family: *NEOCOMITIDAE*, Spath, 1924.

The family Neocomitidae was created for the genera ranging themselves round *Neocomites*, Uhlig, 1905, as reviewed below; they are all connected by morphological transitions and close association in date. It is generally assumed that the genera here grouped in Neocomitidae are derived from various members of Berriasellidae, just as these originated in different groups of the Perisphinctidae, and this may be true in a general way, although I previously doubted it. The obvious difficulty is the existence of so many transitions between "*Hoplites*" and "*Olcostephanus*", for example the species grouped by Djanélidzé[1] in *Dalmasiceras*, or certain doubtful forms classed in *Spiticeras*, *Himalayites*, *Acanthodiscus* or even *Aspidoceras* by different authors according to whether whorl-shape, ornamentation or the suture-line is stressed for classificatory purposes, and whether or not the "evidence" of the inner whorls is taken to indicate ancestry. Other curious types like the remarkable genus *Lytohoplites*, Spath (=group of *Hoplites burckhardti* [Mayer-Eymar MS.] Burckhardt) occupy an entirely isolated position. It must be assumed that none of the families here dealt with is strictly monophyletic and that even genera like *Acanthodiscus* and *Neocomites* (*sensu lato*) include derivatives of various stocks, related only in so far as they are all traceable to some perisphinctid ancestor. It might be held that little is gained by the many new names since it is just as difficult now to place the transitional or isolated forms as when they had to be accommodated in either *Hoplites*, *Perisphinctes* or *Olcostephanus*. There are, however, so many species to each, even in the most restricted sense, that a division into groups is absolutely necessary, and the naming of these "groups" is far more cumbersome and not more helpful to the general geologist or to the memory than the creation of distinct genera, even if some of these are as yet incompletely understood.

Just as the ventral groove of the typical Berriasellids first appeared on the inner whorls of certain Perisphinctids and was, at first, ephemeral, so the tabulate venter of the typical Neocomitids was first developed on the inner whorls of certain Berriasellids. There are, of course, specialised developments in each family, the classification of which is more or less arbitrary; but the difference between Berriasellidae and Neocomitidae is illustrated for example by the two groups into which the genus *Thurmannites* (*olim* "*Thurmannia*") is now divided. The typical forms, of the *roubaudiana* zone, remain truncate to the adult stage, but their fore-runners of the *boissieri* zone, now partly separated as *Subthurmannia*, gen. nov. (see p. 48), may have only a very short truncate stage and then return to the rounded Berriasellid whorl-shape, with or without ventral groove. Other

[1] *Bull. Soc. géol. France*, Ser. IV, Vol. XXI, pp. 334-352, Pls. XII-XIV (1922).

genera to illustrate the difference just referred to are *Andiceras*, Krantz and *Parandiceras*, gen. nov. (p. 76).

Certain Salt Range forms of *Thurmannites*, *Sarasinella* and *Kilianella* are described below, so that these genera need not here be reviewed, but *Neocomites* itself requires discussion, since Sayn's excellent account of the typical species of that genus was not available when Uhlig established *Neocomites* (1905). Of the many species of *Neocomites* listed by the latter author, only *N. neocomiensis* (d'Orbigny, *non* Uhlig) thus remains in the genus, being the genotype, while the remainder are now referred to *Lyticoceras*, Hyatt, 1900 (*cryptoceras* group of Zittel, 1884=*amblygonius* group, *pars*, of Uhlig), and *Distoloceras*, Hyatt, 1900 (*hystrix-curvinodus* group), with *Parandiceras*, gen. nov. (p. 76), *Calliptychoceras* and *Odontodiscoceras*, Spath, 1924, established for the Indian forms described by Uhlig. *Calliptychoceras* (genotype: *Hoplites* [*Neocomites*] *calliptychus*, Uhlig) in which I also provisionally include *Hoplites* (*Neocomites*) *indomontanus*, Uhlig, is as close to *Thurmannites* as it is to the restricted *neocomiensis* group, but is distinguished by its rounded, evolute whorls with first sulcate, then tabulate or even arched venter. *Odontodiscoceras*, also confined to the Himalayas and Tibet, is very distinct on account of its unusually flat ribs, and it is here taken to include the only Spiti fragment of *Neocomites* aff. *neocomiensis* figured by Uhlig.[1]

Steueroceras, Cossmann, 1898 (="*Odontoceras*", Steuer, 1897, invalid through preoccupation), must be used for the group of *S. transgrediens* (Steuer)[2], as I have shown on a previous occasion[3], and it is thus closer to *Lyticoceras* than to *Neocomites* (of an earlier horizon). *Hoplitides*, v. Koenen, 1902, I have previously[4] accepted in Sayn's interpretation, but there is some nomenclatorial difficulty: for as type of this genus must be chosen one of the forms originally designated by the author. Now since *Hoplitides* was based essentially on the peculiarities of the suture-line, *Amm. leopoldi*, d'Orbigny, is clearly indicated as the type of this genus and it thus becomes a synonym of *Leopoldia*, Mayer-Eymar, 1887[5] (=*Solgeria*, Uhlig, 1905). Even *Hoplitides heteroptychus*, Pavlow,[6] or at least the young example figured by v. Koenen,[7] on account of its symmetrical first lateral lobe, cannot be selected as type of a restricted *Hoplitides*. Moreover, it is not constricted, and, as is shown by the comparison of these forms with the closely related tuberculate "variety" of *Thurmannites thurmanni*, figured by Kilian,[8] its selection would not enable us to retain *Hoplitides* in Sayn's sense. For these forms fall within *Sarasinella*, Uhlig, incompletely known when Sayn tried to retain the ill-named *Hoplitides*, confused by Uhlig[9] himself and as recently as 1936 by Besairie[10] with the Upper Cretaceous

[1] Fauna of the Spiti Shales, fasc. 2, p. 246, Pl. LXXXVIII, figs. 3*a-c* (1910), renamed *O. decipiens* on p. 92.

[2] Argentinische Jura-Ablagerungen, p. 40 (166), Pl. XVI (XXX), figs. 11-14 (1897).

[3] *Geol. Mag.*, Vol. LXI, p. 88 (1924). See also Uhlig: Die Fauna der Spiti-Schiefer des Himalaya, etc. *Denkschr. k. Akad. Wiss.* Wien, Vol. LXXXV, p. 74, footnote 3 (1910).

[4] *Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2, p. 151 (1930).

[5] Systematisches Verzeichniss der Kreide und Tertiär-Versteinerungen, etc. *Beitr. geol. Karte Schweiz.* Beil., Lief. 24, Pt. II, p. 77 (1887).

[6] Argiles de Speeton, p. 109, Pl. XVIII (XI), fig. 22 (1892).

[7] Ammonitiden des norddeutschen Neocom, p. 217, Pl. VII, figs. 10*a-c* (1902).

[8] *Bull Soc. Statist. Isère*, Pl. IV, figs. 2-3 (1892).

[9] Fauna of the Spiti Shales, fasc. 2, p. 179 (1910).

[10] *Mém. Acad. Malgache*, fasc. XXI, pp. 142-143 (1936).

genus *Hoplitoides* (also v. Koenen's), and used by Franke[1] for what is now known as *Deshayesites*. It does not seem necessary to apply for a ruling by the International Committee of Zoological Nomenclature, and I thus propose to ignore *Hoplitides*, while the group of "*Hoplitides*" *submartini* (Mallada), connected with *Kilianella* by forms like *K. constricta*, Uhlig, and with *Sarasinella* and *Acanthodiscus* by *N. arnoldi* (Pictet and Campiche), is given a new generic name (*Neohoploceras*, discussed on p. 107).

Leopoldia is not represented in the Salt Range material before me nor is its ally and contemporary *Acanthodiscus* (restricted to the *radiatus* group), for the Valanginian form here described as *Neocosmoceras*? ("*Acanthodiscus*") sp. ind. has nothing to do with *A. radiatus* (Bruguière). The (equally Hauterivian) subcarinate or keeled derivatives of the Neocomitidae that have been referred to *Oosterella*, Kilian, 1910, *Pseudoosterella*, and *Suboosterella*, Spath, 1924, and such special developments of doubtful date as *Hatchericeras*, Stanton, 1901, and *Proleopoldia*, Spath, 1923, are also unknown from the Salt Range. *Hatchericeras* may not even be related to the Neocomitids, but, as in the case of *Favrella*, R. Douvillé, 1909,[2] presumably a Berriasellid genus, its horizon is still unknown.

Genus: PARANDICERAS, nov.

Genotype.—*P. rota*, sp. nov., p. 77, Pl. XV, figs. 1*a*, *b*.

Diagnosis.—More or less evolute, discoidal, shells with subtrigonal whorl-section and grooved or tabulate periphery, bordered by two distinct edges formed of nodate terminations of ribs. Costation simple, straight or inclined, and bifurcating at or above middle of whorl-side. Shallow constrictions and occasional irregularities in the ribbing occur. Suture-line complex.

Remarks.—This genus is as near to *Thurmannites* as it is to *Andiceras*, Krantz, and it is distinguished from the former by its evolution, subtrigonal whorl-shape and ribbing which only rarely shows a node at the vertical umbilical wall where the ribs generally begin singly. *Andiceras* has the venter less differentiated and a generally more perisphinctoid aspect, but it is probably connected with *Parandiceras* by passage-forms like *P. theodorii* (Steuer, *non* Oppel) which requires a new name. *Parandiceras* thus stands in the same relationship to *Andiceras* as *Thurmannites* does to *Subthurmannia*, and in both the differentiation of the periphery that is responsible for the inclusion of the present genus and of *Thurmannites* in the family Neocomitidae, begins on the inner whorls. *Parandiceras* does not seem to be typically represented in the Spiti Shales, but *Neocomites theodorii* (Oppel) Uhlig[3] is transitional between *Parandiceras* and *Calliptychoceras*. *Odontoceras fallax* (Steuer) also belongs to the present genus, unless the peripheral view is misleading. The resemblance of another Andine form (*Reineckeia incerta*,

[1] Die Entfaltung der Hopliten in der unteren Kreide Nord-deutschlands. *Jahrb. Preuss. Geol. Landesanst.*, Vol. XXXIX, p. 401 (1918), 1920.

[2] Krantz (*Steinmann Festschrift*, 1926, p. 483) assigns *Favrella angulatiformis* (Behrendsen) to the Valanginian upper *Spiticeras* beds, and on p. 489 suggests that the principal horizon of *Hatchericeras* and *Favrella* may be as high as the Hauterivian.

[3] Fauna of the Spiti Shales, fasc. 2; Pl. LXXXIX, fig. 1 (1910).

Steuer, included by Krantz in his genus *Andiceras*) to *Subthurmannia* of the *fermori* group is significant, for the two genera are closely allied.

53. Parandiceras rota, sp. nov.

(Plate XV, figs. 1*a*, *b*.)

Diagnosis.—Substenogyral, subleptogyral, sublatumbilicate *Parandiceras*. Whorl-section compressed, with convex sides, greatest thickness at about the middle, and low but vertical umbilical wall. Venter narrowly contracted, first deeply sulcate, then more tabulate, and with terminations of ribs forming two rather prominent and very approximate ridges, each side of ventral groove. Ribs single and bifurcating, inclined forwards and very slightly flexuous; apparently none meeting at an umbilical tubercle. Point of bifurcation at or above middle of side. Suture-line very complex, apparently as in *Subthurmannia*.

Measurements.

Diameter	82 mm.
Height of last whorl	32%
Thickness of last whorl	24%
Umbilicus	43%

Remarks.—Although the point of bifurcation of the ribs in the entirely septate holotype is at various heights, there is considerable regularity, which suggests comparison to *Thurmannites* rather than to *Neocomites*. The open umbilicus and the comparative straightness of the ribbing, however, seem to prevent comparison with either genus in the restricted sense. Even *Thurmannites kingi* (Uhlig),[1] a Spiti fragment of which is figured in Pl. XIV, figs. 8*a*, *b*, or the forms of the group of *Hoplites* (*Neocomites*) *indicus*, Uhlig[2] (compare Pl. XIV, figs. 7*a*, *b*), are considerably more advanced, but *Amm. theodorii*, Oppel[3], is decidedly closer. It is significant that Steuer[4] identified with Oppel's species a form of *Andiceras* (*Odontoceras* in Steuer) which shows resemblance to the species here described, except in peripheral aspect. It is probable that *Andiceras* is one of the direct fore-runners of the Neocomitids of the *theodorii* group which are somewhat intermediate between *Parandiceras* and *Calliptychoceras*. But *Andiceras*, stated to be a Valanginian element, though of Jurassic aspect, is just one of the links between the Neocomitids and the ancestral *Aulacosphinctes*, together with which it already occurs, and the affinity of the forms here described with some *Subthurmannia* or rather *Berriasella* (in lateral aspect only), as well as the occurrence of so many transitional types in the Andine region (described as *Thurmannia* by Gerth, Krantz and Weaver) make it probable that the ramifying lineages that gradually took on more typically Neocomitid peripheries are as yet very incompletely known. Unfortunately the Salt Range forms, like so many Lower Cretaceous faunas, are badly preserved.

[1] Fauna of the Spiti Shales, fasc. 2, p. 235; Pl. LXXXVI, figs. 3*a*, *b* (1910).
[2] *Ibid.*, p. 262; Pl. LXXXIX, figs. 3-6.
[3] Über Ostindische Fossilreste. *Pal. Mitteil.* IV, Pt. 1, p. 280; Pl. LXXVIII, figs. 3*a-c*; Pl. LXXXIII, figs. 2*a*, *b* (1863)
[4] Argentinische Jura-Ablagerungen, p. 48 (174); Pl. XX (XXXIV), figs. 5, 7, 9 (1897).

Andiceras fallax (Steuer),[1] linked by Uhlig,[2] though doubtfully, with the group of "*Neocomites*" *theodorii* (and *Lyticoceras volgense*, Uhlig) differs from the form here described chiefly in having no clearly cut siphonal groove, but the drawing of the side-view is rather too unsatisfactory for exact comparison. The form described below as *P.* sp. nov. ind. has different proportions.

Horizon.—Neocomian (Belemnite Beds).

Locality.—700 (1).

54. Parandiceras, sp. nov. ind.

(Plate XIII, figs. 3*a-d*.)

This form differs from that last described in dimensions which are as follows :—

Diameter	89 mm.
Height of last whorl	40%
Thickness of last whorl	30%
Umbilicus	33%

The whorl-height thus is considerably greater, but the umbilicus is narrower and the thickness is more, the lower half of the sides being more inflated. On the whole of the septate half shown in Pl. XIII, figs. 3*a*, *b*, the venter is narrowly tabulate, the faint sulcus being due merely to the nodate terminations of the ribs forming two distinct edges. The ribs are inclined forwards and projected near the periphery. They are apparently all bifurcating, at or just above the middle of the whorl-side, and, apart from a few very shallow constrictions, the ribbing is fairly regular. This comparative regularity is well shown in the fragment depicted in Pl. XIII, fig. 3*d*, which, however, has lost the conspicuous ventro-lateral ridges by corrosion or weathering. Both fragments show the suture-line, as does a third specimen, the badly preserved outer whorl of which has been partly removed (Pl. XIII, fig. 3*c*). The suture-line is very complex, with a deep, trifid first lateral lobe, slender saddles and three oblique auxiliary lobes on the umbilical edge and wall.

Except in peripheral aspect, the present form resembles species of *Subthurmannia* more than any other genus. In the form described below as *Thurmannites* (*Kilianella* ?) sp. nov. the inner whorls are more flexiradiate and the periphery is quite different. *Thurmannia keideli*, Gerth,[3] has a wider umbilicus and more irregular costation which agrees with that of the typical *Thurmannites* but is merely curved forwards, so that it may also belong to *Parandiceras*, like the form here described.

Horizon.—Neocomian (Belemnite Beds).

Localities.—682 (4); 700 (3); 791 (1); 814 (1 ?); Malla Khel (6).

55. Parandiceras (?) theodorii (Oppel).

(Plate XIII, fig. 2, Plate XVIII, fig. 3.)

It has already been mentioned that Oppel's species, refigured by Uhlig, is somewhat transitional to *Calliptychoceras* because its ribbing is considerably more

[1] Argentinische Jura-Ablagerungen, p. 52 (178); Pl. XIV (XXVIII), figs. 1-2.

[2] *Sitz. Ber. k. Akad. Wiss., Wien*, Vol. CXIV, 1, p. 623 (1905).

[3] *Act. Acad. Nac. Cienc., Rep. Arg.*, Vol. IX, p. 95; Pl. V, figs. 1, 1*a* (1925).

flexuous and more irregularly branching than that of the typical *Parandiceras* (compare Uhlig's[1] fig. 1*a* of Pl. LXXXIX with *Andiceras trigonostomum*, Krantz,[2] which has the same type of ribbing as *P. rota*). The small fragment figured in Pl. XIII, fig. 2, is too poorly preserved for accurate comparison, but unlike the two forms above described it has tubercles at the umbilical edge. These as well as the irregular branching of the flexuous ribs point to affinity with Oppel's species which, however, seems to be slightly less coarsely ornamented, with the finer ribs somewhat more closely spaced. The whorl-section (thickness=24 mm. where height=28 mm.) is very similar but slightly less compressed in the Salt Range fragment. A second and still smaller example is probably identical with Oppel's large type, being more compressed and more finely ribbed than the figured example, but it is somewhat weathered. Two more specimens are very doubtful because they are much corroded.

After the above was written I received, among other fragments, the example figured in Pl. XVIII, fig. 3 and, too late for figuration, a still more typical individual, which prove that Oppel's species does, indeed, occur in the Trans-Indus Range. The dimensions of these two examples are :—

	No. K 40/158(*c*)	Plate XVIII, fig. 3
Diameter	66	58 mm.
Height of last whorl	40	40%
Thickness of last whorl	34	30%
Umbilicus	32	32%

There is good general agreement in ribbing, whorl-shape and periphery with Oppel's holotype, as refigured by Uhlig ; the umbilical tubercles are only beginning to become prominent at the end. The suture-line shows a comparatively large and wide, almost symmetrically trifid, first lateral lobe and a very small second lateral lobe. The saddles are fairly complex and the general plan of the suture-line is that of the closely allied *Neocomites indicus*, Uhlig,[3] but the first lateral saddle is as high as the external saddle.

Horizon.—Neocomian (Belemnite Beds).

Localities.—682 (2) ; 791 (2 ?) ; 814 (2) and Baroch Gorge, No. K 40/158*c* (I).

Genus : THURMANNITES, Kilian and Reboul, 1914.

56. THURMANNITES cf. PERTRANSIENS (Sayn).

(Plate XII, figs. 2*a*, *b*.)

The reference of this small, septate fragment to Sayn's[4] species must, of course, be taken to be provisional, since the inner whorls are unknown. There are also slight differences in the suture-line which, in the Indian form, has the outer of the two leaflets subdividing the first lateral lobe much higher than the inner, a feature which is more conspicuous in *Leopoldia*, but which is indicated

[1] Fauna of the Spiti Shales, fasc. 2 (1910).
[2] *Steinmann Festschrift*, p. 451 ; Pl. XVI, figs. 3-4 (1926).
[3] *Op. cit.*, p. 262 ; Pl. LXXXIX, fig. 6 (1910).
[4] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 43, Pl. IX (V), fig. 10 (lectotype) (1907).

already in *T. thurmanni* (Pictet and Campiche)[1]. The second lateral saddle is also well away from the tubercle at the umbilical edge, but this may be correlated with the larger size of the Salt Range example which, at the two ends, has a whorl-height of 28 and 31 mm. and a thickness of 19 and 22 mm., respectively. The whorl-section consequently is as angular as in Sayn's[2] largest example of *T. thurmanni*, but the next inner whorl, partly preserved in the dorsal area of the fragment here figured, was more rounded, as in Sayn's *T. pertransiens*. It appears probable, however, that the roundness of the periphery (in casts) is deceptive, for the tubercles at the ventro-lateral edges disappear with the test. It may be added that the siphuncle is shown in both whorls and is of an unusually large size (7 per cent. of whorl-height).

The form here compared to *Neocomites perisphinctoides*, Uhlig (see p. 89), has much sharper ribbing than the present species, but is similar in peripheral aspect, also having periodical irregularities in the ventral pairs of nodes. *Sarasinella uhligi*, sp. nov., on the other hand, with only slightly less close costation, may be even more nearly related to the present form, so that the generic position also is uncertain in the absence of the inner whorls (compare figs. 2*b* and 5 of Plate XII).

The four small examples of *T. pertransiens* and its var. *loryi*, Sayn, figured by Baumberger[3] from Sumatra cannot well be compared with the larger fragment here described on account of defective preservation.

Horizon.—Valanginian (Belemnite Beds).

Locality.—687 (1).

57. Thurmannites (Kilianella ?) sp. nov.

(Plate X, figs. 9*a-c*).

If only the inner whorls of the example here figured had been preserved, it might well have been identified with *T. thurmanni* (Pictet and Campiche) in Sayn's[4] interpretation, the latter author's fig. 5 of his Pl. V, representing a widely umbilicated variety, being essentially similar in ribbing and whorl-shape. The resemblance, however, is somewhat deceptive; for the early whorls of the Indian form, rounded and not flattened, are very finely ribbed and gradually develop the kind of costation shown on the outer whorl of Sayn's example, to change it again for comparatively distant, single and bifurcating flexicostae of the *Blanfordiceras* type at a diameter of less than 40 mm. In the French form on the other hand, the ribs are closer at the end than at the beginning of the last whorl, and judging by the limonitic young *Thurmannites* before me (from Luc-en-Diois) the early stages, with flat whorl-sides and a sharp umbilical edge already at a small size, are different in the French form.

The venter in the Indian species here described also changes from sulcate to subcarinate, the ventral terminations of the ribs meeting along the siphonal

[1] See in Kilian, *Bull. Soc. Statist. Isère*, text-fig. 1 on p. 9 (1892).
[2] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 40, Pl. V (IX), figs. 1*a*, *b* (1907).
[3] Gedenkboek Verbeek p. 25, Pl. III, figs. 6*a*, *b*; 7*a*, *b* (1925).
[4] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 40 (as *Thurmannia*) (1907).

line in chevrons directed forwards and connected together, almost as in Pavlow's[1] *Lyticoceras oxygonium*. But there is no ventro-lateral node and the chevrons are not nearly so acute as in *Lyticoceras*. Even in *Kilianella* ? aff. *pexiptychoides*, Spath[2] (=*Hoplites roubaudi*, Pavlow[3], *non* d'Orbigny), there are two ventro-lateral rows of sharp tubercles, making it transitional to *Lyticoceras*; but there is resemblance in the lateral ribbing between the Indian form and the typical *Kilianella roubaudiana* (d'Orbigny) which is a closer ally of *Thurmannites* than is the earlier *Blanfordiceras*. The form described below as *Kilianella asiatica*, sp. nov., in fact, though having entirely different inner whorls, has a peripheral aspect very similar to that of the final portion of the present species.

There is at least one constriction, a feature not unknown in *Thurmannites*; and when it is remembered how slight is the gulf that separates for example *T. salientinus* (Sayn)[4] from *Kilianella bochianensis* (Sayn)[5] it will be seen that the systematic position of the form here described is not so anomalous as seems at first sight. Since, however, the final portion of the form here described is already body-chamber, it is clear that it could not have developed into a flat platycone, like the typical *Thurmannites*.

There is a more finely ribbed variety of the present form which retains the peripheral aspect shown in Plate X, fig. 9*b*, to a diameter of at least 50 mm., that is to say, the ribs do not become so widely spaced on the last half whorl as in the figured example. The inner whorls of this variety are indistinguishable from those of the typical example and are figured separately in Plate IX, figs. 6*a*, *b*. They are constricted, like those of young *Thurmannites*, in Sayn's interpretation, and the simple suture-line with its very small second lateral lobe is asymmetrical, owing to the siphonal line coinciding with one of the ventro-lateral edges.

Horizon.—Neocomian, Belemnite Beds.

Locality.—700 (2).

58. Thurmannites (?) sp. ind. cf. pronecostatus (Felix).

(Plate X, fig. 6.)

Yet a different species is represented by a septate fragment of an ammonite of about 115 mm. diameter, but the whorl-sides are too much corroded to be figured. They were comparatively smooth, however, as in *Hoplites* (*Neocomites*) *scioptychus* (Uhlig)[6] and the only flexuous and prorsiradiate, blunt, primary rib visible, ending in an umbilical node, was apparently widely separated from its neighbours. The secondary ribs, visible on the rounded ventro-lateral edges, are unequally spaced, apparently on account of some shallow constrictions, and they are not markedly nodate, but there is only slight projection of the ribbing as a whole and they run almost straight up to the smooth siphonal zone.

[1] Argiles de Speeton Pl. XVII (X), fig. 4*b* (1892), upper part (*Hoplites oxygonius*, Neumayr and Uhlig).
[2] *Geol. Mag.*, Vol. LXI, p. 76 (1924).
[3] Argiles de Speeton p. 464, Pl. XVII, fig. 8 (1892).
[4] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 45, Pl. IX (V), figs. 6*a*, *b* (lectotype) (1907).
[5] *Ibid.*, p. 46, Pl. X(VI), figs. 4*a*, *b* (lectotype).
[6] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 57 : Pl. V, figs. 1*a*, *b* (1902).

The venter is flattened and the high and steep umbilical wall causes a whorl-section similar to that of *T. thurmanni* (Pictet and Campiche) var. *allobrogica*, Kilian, as figured by Baumberger[1].

What little could be secured of the next inner whorl, in the dorsal area, shows ribbing, including one bidichotomous rib, similar to that of *Neocomites* (?) *perisphinctoides* (Uhlig)[2], but more closely spaced, almost as in *Thurmannia* cfr. *thurmanni* (Pictet and Campiche) var. *allobrogica*, Kilian, as figured by Rodighiero[3]. The venter was tabulate, even then, and the suture-line has an unsymmetrically trifid first lateral lobe, with the outer leaflet much larger than the inner, as in the suture-line of a "*Thurmannia*" *campylotoxa* figured by Roch[4].

It is not probable that the form here described represents a large example of *N.* (?) *perisphinctoides*, for the periphery is tabulate already on the inner whorl and there is no reason for believing that species to lose its ribbing at a later stage. The peripheral aspect, however, with the straight ribs, is somewhat similar, and it differs from that of all the species of *Neocomites* here described, or large forms like *N. longi* (Sayn) in Roch[5]. The fragment here (p. 79) referred to *Thurmannites* cf. *pertransiens* (Sayn), however, is similar and might possibly have developed an outer whorl like the present form. The difficulties of identification of such a fragment are increased by the fact that Sayn's pyritised examples are all small, whereas the somewhat diagrammatic *Thurmannites thurmanni* of Baumberger[6] and especially Pictet's type, do not appear to be as close to the present species as is for example the constricted *Neocomites* (?) *perisphinctoides*.

After the above was written I received three small fragments of a similar form that had been labelled by Folgner "*Solgeria leenhardti*, Kilian". That species was based on *Ammonites neocomiensis*, Pictet[7] *non* d'Orbigny, but in 1910 Kilian[8] himself considered it synonymous with *Hoplites* (*Leopoldia*) *pronecostatus*, Felix, apparently in Karakasch's[9] interpretation. There is indeed great resemblance to Pictet's fig. 2 in peripheral aspect, but the lateral ribs are far less straight in the Salt Range form (see Plate XXI, fig. 7) and the terminations at the ventro-lateral edges are therefore more oblique. The Crimean forms of *Leopoldia* figured by Karakasch on the other hand seem to me to be less closely related to the species here discussed. One of the fragments shows the overhanging umbilical wall and an impression of part of the penultimate whorl that make it probable that it is close to the forms here described as *Neocomites* (*Thurmannites* ?) sp. ind. (No. 65) and *Sarasinella chichalensis*, sp. nov. (No. 74). All these Salt Range forms retain an angular periphery to the adult, also a comparatively open umbilicus, and whatever the affinity of the Crimean ammonites, there is certainly no resemblance of the former to the true *Leopoldia leopoldina* and allies before me from French and Swiss localities (*e.g.*, B. M. Nos. C.2754,

[1] *Abh. Schweiz. pal. Ges.*, Vol. XXXII, p. 60, text-fig. 37 (1905).
[2] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 51; Pl. VI, figs. 2*a-c* (1902).
[3] *Pal. Italica*, Vol. XXV, Pl. XI (IV), fig. 8 (1922).
[4] Études géologiques Maroc occidental, p. 306, text-fig. 55 (1930).
[5] *Ibid.*, p. 273; Pl. XII, figs. 1*a-d*.
[6] *Abh. Schweiz. pal. Ges.*, Vol. XXXII; Pl. VI, fig. 5, said to be apparently typical (p. 60) (1905).
[7] Mat. Pal. Suisse, Sér. II, Vol. II, p. 247; Pl. XXXIII, figs. 1-3 (1860).
[8] Lethaea geognostica, fasc. 2, p. 220 (1910).
[9] *Trav. Soc. Imp. Nat. St. Pétersb.*, Vol. XXXII, p. 87; Pl. X, fig. 10; Pl. XI, fig. 1 (1907).

C.4037, etc.). The reference to *Solgeria* (a synonym of *Leopoldia*) also is not acceptable, but it should be mentioned that Folgner used this genus for the group of *Hoplites karakaschi*, Uhlig, and *H. inostranzewi*, Karakasch, *i.e.*, in a more restricted sense than Uhlig.

Horizon.—Neocomian, Belemnite Beds.

Localities.—687 (1); Chichali Pass (3).

Genus: NEOCOMITES, Uhlig, 1905.

59. NEOCOMITES SIMILIS, sp. nov.

(Plate XI, figs. 4-5, Plate XVIII, figs. 6*a*, *b*.)

Diagnosis.—Like *N. neocomiensis* (d'Orbigny), as interpreted by Sayn[1], but with a different rib-curve, more peripheral projection and a higher but less steep umbilical slope. Suture-line with second lateral saddle at umbilical bulla which is comma-shaped and scarcely thickened. Three auxiliary lobes on umbilical slope.

Measurements.

	Holotype (Plate XI, fig. 5).	Paratype (Plate XI, fig. 4).
Diameter	56	31 mm.
Height of last whorl	48	45 %
Thickness of last whorl	30	35 %
Umbilicus	23	23 %

Remarks.—The increased whorl-thickness of the paratype may be due to a slight deformation which has forced the end of the last whorl out of the regular spiral. The comparatively inflated penultimate whorl of the larger holotype, however, shows a wider periphery than the paratype, so that, if the two examples were complete, their specific identity might not be so perfect as appears from the figures. Sayn interpreted *N. neocomiensis* in a fairly wide sense and included in it compressed and inflated, finely and more coarsely ribbed varieties; his forms, however, show much greater differences among themselves than do the two Salt Range examples.

The large and entirely septate example figured in Plate XVIII, fig. 6, belongs to a form which is somewhat intermediate between the present species and *N.* sp. nov. aff. *platycostatus* (Sayn); but it is now included in the former as a variety (var. *inaequalis* nov.) because its preservation is rather too defective for the creation of a new species. Moreover, the suture-line is not exposed; and apart from the fact that the ribbing is more flexuous in the variety, the last half-whorl, if found isolated, might well have been identified with this species. The earlier part of the outer whorl, however, in the variety, shows slight constrictions, preceded by ribs which at the ventro-lateral terminations swell so as to form tubercles which are distinctly larger than those of the remainder of the ribs. There is one such accentuated rib just before the break and three after. This type of

[1] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 29; Pl. III (VII), figs. 4-12 (1907).

ornamentation is found also in the form described below as *Sarasinella uhligi* (No. 63), but the ribbing is less close in that species, the umbilicus is wider and the whole aspect is less neocomitid than that of the var. *inaequalis*. The dimensions, which are as follows :—

Diameter	76 mm.
Height of last whorl	50 %
Thickness of last whorl	33 %
Umbilicus	22 %

are in tolerable agreement with those of the holotype of the present species.

N. madagascariensis, Besairie,[1] which may be based on the inner whorls of a large, evolute *Thurmannites*, has more flexuous ribbing and more conspicuous umbilical tubercles, also a different and much more inflated whorl-section. In the typical *N. neocomiensis* (d'Orbigny), *e.g.*, B. M. No. 73685, the flexuous costation and tabulate periphery, with flattened whorl-sides, are developed already at a very small diameter. On the earlier half of the outer whorl of the paratype of the present species, on the other hand, the venter is still grooved, the whorl-sides are convex, and the ribs are merely curved forwards. This causes some resemblance to the immature Neocomitid described by Sayn[2] as *Leopoldia aenigmatica*, which, however, has a different peripheral aspect and a much simpler suture-line. *Neocomites paraplesius*, Uhlig[3], with a wider periphery but somewhat similar though coarser ribbing, has the umbilical bullae much more strongly developed. The Spiti forms of the group of *Hoplites* (*Neocomites*) *montanus*, Uhlig[4], are far less closely comparable to the Salt Range species than is the European *N. neocomiensis*.

Two small fragments of a form similar to the present but with the ventro-lateral edges more rounded and a tendency to smoothness in the adult may have belonged to yet another species of *Neocomites*.

Horizon.—Neocomian (Belemnite Beds).

Localities.—687 (2); 50 (1); 675 ? (2).

60. Neocomites, sp. nov. aff. platycostatus (Sayn).

(Plate XV, figs. 9*a*, *b*; Plate XVII, figs. 4*a*, *b*.)

A dozen fragments, four of which are here figured, belong to a form of the group of *N. platycostatus*, Sayn[5] (=*N. pseudopexiptychus*, Baumberger)[6] and *N. teschenensis* (Sayn[7], *non* Uhlig ?), but they have their own peculiar ribbing. This consists of single and bifurcating costae, the point of branching of the latter

[1] *Mém. Acad. Malgache*, fasc. XXI, p. 143, Pl. XIV, figs. 11-12 (1936).

[2] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 54, Pl. III (VII), figs. 26*a*, *b* (1907).

[3] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 59, Pl. II, figs. 8*a*, *b*, *c* (as *Hoplites*) (1902).

[4] Fauna of the Spiti Shales, fasc. 2, p. 249, Pl. XC, figs. 1 and 5 (1910).

[5] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 33, Pl. III (VII), fig. 1 (1907).

[6] In Baumberger and Heim : Pal.-strat. Untersuchung zweier Fossil-horizonte an der Valangien-Hauterivien Grenze im Churfirsten-Mattstockgebiet, etc. *Abh. Schweiz. pal. Ges.*, Vol. XXXIV, p. 20, Pl. I, figs. 2-3, 1907 (1908); also *Gedenkboek Verbeek*, p. 23, Pl. III, figs. 1-2 (1925).

[7] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 32, Pl. III, figs. 13*a*, *b* only.

being either at or near the umbilical edge, or else halfway up the whorl-side. The ribs are distinctly sigmoidal, as in the two species just mentioned, and they are thickened at the ventro-lateral edges where occasionally a rib-pair forms more or less conspicuous tubercles, the number of intervening ribs being two, three or four. In the larger fragments, the difference between the ventral terminations of the ribs is not so noticeable though undoubtedly present. The periphery itself is subtabulate, with the smooth siphonal line tending to form a low keel between the two raised rows of ventro-lateral nodes, somewhat as in Sayn's fig. 13*b*. The whorl-section is similar to that of *N. teschenensis* (Uhlig ?) Sayn, with the greatest thickness between the middle of the whorl-side and the high and vertical umbilical wall and its rounded edge.

The suture-line has a deep first lateral lobe, as in *N. scioptychus* (Uhlig)[1] but the two lateral saddles are slenderer. The first auxiliary saddle is on the rounded umbilical rim and it is followed by two more lobes on the umbilical wall. The external saddle and the ramifications of the principal lateral lobe are similar to the corresponding elements in Uhlig's species.

In the true *N. teschenensis* (Uhlig)[2] the ribs are more equal and the branching occurs lower down on the whorl-side, but the general aspect and the venter are similar. Sayn considered *N. teschenensis* to be only an extreme variety of *N. neocomiensis* and I agree that *N. platycostatus* (Sayn) again is merely an extreme form of *N. teschenensis*, so that their inclusion in the restricted genus *Neocomites* is justified, even if more evolute forms like *Kilianella besairiei*, described below, also show leanings towards *N. platycostatus*, and others, by the aquisition of lateral tubercles, pass into *Sarasinella*.

The Madagascan ammonite figured by Barrabé[3] as *Neocomites* cf. *platycostatus* (Sayn) probably belongs to the same group as the present form, but in the absence of a sectional view and especially on account of the very prominent umbilical tubercles of the Madagascan species, identification of the two is impossible. A third form of the *platycostatus* group is figured in Plate XVII, figs. 1*a*, *b*, because it shows a surprising change of shape with increase in size. The outer whorl, which, on the figured side, does not show the umbilical edge and wall, might even be mistaken for that of a *Taramelliceras*, the suture-line also being similar. This is of interest since Kilian and Reboul[4] claimed the persistence of the Kimmeridgian *Taramelliceras* ("*Neumayria*") *compsum* (Oppel), or at least a variety thereof into the Cretaceous. The new stock, in any case, is generically distinct from *Neocomites*; but as the only fragment available is still septate and the body-chamber may be yet different, it is necessary to await the discovery of more material before naming this genus.

Horizon.—Neocomian (Belemnite Beds).

Localities.—682 ? (5); 685 (1); 687 (10); 692 (4); 814 (2).

[1] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, Pl. IV, fig. 10 (1902).

[2] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 56, Pl. III, figs. 4*a*, *b* (1902).

[3] Contribution à l'Étude stratigraphique et pétrographique de la partie median du Pays Sakalave (Madagascar). *Mém. pal. Soc. géol. France*, N. S., Vol. V, fasc. 3 and 4 (Mém. No. 12), p. 167, Pl. XXII (VIII), fig. 16 (1929).

[4] *C. R. Assoc. franç. Av. Sci.*, Congrès de Tunis, 1913, 1914, p. 3; see also: Sur quelques Ammonites de l'Hauterivien de la Bégude. In Kilian: Contribution à l'étude des faunes paléocrétacées du S. E. de la France, II. Mém. Explic. Carte géol. France, p. 250, Pl. XII, fig. 1 (1915).

61. NEOCOMITES, sp. nov. cf. TESCHENENSIS (Uhlig).

(Plate XV, figs. 5*a*, *b*).

The Salt Range fragment here figured differs very slightly from a Madagascan example represented in Plate XV, figs. 6*a*, *b*, but both belong to the same species which differs from *N. teschenensis* (Uhlig)[1] chiefly in the peripheral aspect. Both are body-chamber fragments and whereas the Indian example shows the outline of the last septal edge, the Madagascan specimen shows the peripheral ornamentation of the penultimate whorl, preserved in the dorsal area, so that a squeeze of this could be figured (fig. 6*c*). In having the siphonal line raised into a blunt keel and in having the ribs join up to this keel in acute chevrons, the periphery of this inner whorl is thus much like the venter of the larger Salt Range fragment, whereas the outer whorl of the Madagascan example, near the end, has the ribs almost continuous across the venter, as in certain *Deshayesites*. It is probable, however, that this difference merely depends on the proximity of the aperture.

The ribbing is identical in the two examples, irregular, flattened and strongly flexuous, much as in Uhlig's species, but less closely spaced[2] and not stopping at the ventro-lateral edges. The whorl-section is compressed, with flattened, almost parallel, sides, and a low but steep umbilical edge, with a well-rounded border. In the larger fragment the thickness is 23 mm. where the whorl-height is 37 mm. The details of the suture-line are not preserved, on the figured example, but in two more large and septate, though somewhat doubtful, fragments it can be seen to be complex.

Hoplites campylotoxus, which was subsequently referred by Uhlig,[3] though with doubt, to *Sarasinella*, also resembles the present new species but differs in having umbilical tubercles and, in some varieties, even a suspicion of a lateral tubercle at the point of bifurcation of the ribs. Sayn[4], who put Uhlig's species in the genus *Thurmannia*, figured a smaller example which is less closely comparable to the Indian form, and, if correctly identified, shows that at least some of the resemblance to Uhlig's species may be due to accidental flattening of the ribbing in the latter rather than to close affinity with the present species.

N. neocomiensiformis (Hohenegger MS.) Uhlig[5] sp. (=*Hoplites neocomiensis* var. Uhlig, *non* d'Orbigny) which shows somewhat similar ribbing on the outer whorl, also has prominent umbilical tubercles, but in peripheral aspect it is probably closer to the Indian form than is *N. teschenensis*.

Horizon.—Valanginian (Belemnite Beds). Cohen[6] has lately recorded this species from N. E. Bulgaria, associated with the Infra-Valanginian *Spiticeras* as well as the Hauterivian *Holcodiscus*.

Locality.—687 (3).

[1] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 56, Pl. III, figs. 4*a*, *b* (1902).

[2] If Baumberger (*Gedenkboek Verbeek*, p. 23, Pl. I, figs. 7*a*, *b*, 9*a*, *b*, Pl. III, fig. 8 1925) has correctly interpreted Uhlig's species, then the new form here described would seem to require a new name.

[3] *Op. cit.* (Fauna of the Spiti Shales, fasc. 2), p. 173 (1910).

[4] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 3-4, p. 42, Pl. IX (V), fig. 12 (1907). In 1932, Sayn and Roman (*C. R. Somm., Soc. géol. France*, No. 2, p. 17.— Séance du 18 janvier, 1932) considered beds with *Toxaster* and *Thurmannites campylotoxus* to be Lower Hauterivian.

[5] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 54, Pl. III, figs. 1-2 (1902).

[6] Geologie des Dervent-Dervis Gebirges. *Zeitschr. Bulgar. Geol. Ges.*, Vol. V, Heft 2, p. 169 (1933).

62. Neocomites sp. nov. ind. cf. noriciformis (Hohenegger MS.).

(Plate XXIII, figs. 15*a*, *b*).

The example of which two peripheral views are here given is poorly preserved and corroded laterally, but in side-view it resembles the new species figured by Uhlig[1], as *Hoplites* n. sp. ind., at a comparable diameter. The only difference, so far as can be seen in the circumstances, is that the ribbing is slightly less close, there being only 15 ribs on the Indian specimen in the same length of periphery (90°) that shows 18 in Uhlig's form. Later, the secondaries tend to be still farther apart, and they are more inclined forwards, while the primary ribs also are less closely spaced than in the Teschen species. The periphery is almost as broad as in a form attached by Uhlig[2] to his *Hoplites ambiguus*, the genotype of *Sarasinella*. Since the peripheral ribs, however, are scarcely thickened but far more projected, the ventro-lateral edges are rounded and not so clearly marked. The suture-line shows only the short external lobe, found in all the forms of this group, and the deep and large first lateral lobe, the two leaflets in which are equal and symmetrical.

Hohenegger's MS. name may well be retained for Uhlig's species, for, although venter and suture-line are not known, the ribbing is rather distinctive. The less closely ribbed Indian form is almost certainly another new species. Three doubtful large fragments listed below and provisionally included here may belong to yet different species, but like the figured example are different from all the other forms here described.

Horizon.—Neocomian (Belemnite Beds).

Localities.—682 (1); 687 (2); Baroch Nala, Malla Khel (1).

63. Neocomites aff. neocomiensiformis (Hohenegger MS.) Uhlig.

(Plate XXII, figs. 11*a*, *b*).

1902. *Hoplites neocomiensis* (d'Orbigny) var. (*A. neocomiensiformis*, Hohenegger msc.) Uhlig, *loc. cit.* (*Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII), p. 54, Pl. III, figs. 1-2.

1910. *Hoplites neocomiensiformis* (Hohenegger) Kilian, *loc. cit.* (Lethaea geognostica, fasc. 2), p. 221 (probably misinterpreted).

non 1915. *Neocomites neocomiensiformis* (Hohenegger) Uhlig sp. Kilian and Reboul, *loc. cit.* (*Mém. Explic. Carte géol. France*), p. 228, Pl. XV (Pl. X, fig. 2, Pl. XII, fig. 4).

1916. *Hoplites* (*Neocomites*) *neocomiensiformis* (Hohenegger) Somogyi, *loc. cit.* (*Mitteil. Jahrb. k. Ungar. geol. Reichsanst.*, Vol. XXII), p. 348.

non 1925. *Hoplites* (*Neocomites*) *neocomiensiformis*, Uhlig; Corroy: Le Néocomien de la bordure orientale du Bassin de Paris. (Nancy), p. 183.

non 1933 ? *Neocomites neocomiensiformis* (Hohenegger) Uhlig; Roman: *Loc. cit.* (*Trav. Lab. géol. Lyon*, fasc. XXII, Mém. 19), p. 15, Pl. II, figs. 2, 2*a*.

non 1936. *Neocomites* aff. *neocomiensiformis* (Hohenegger, in Uhlig) Breistroffer: Revision Faune hauterivienne du Neron en Chartreuse (Isère). *Bull. Soc. Sci. Dauphiné*, ser. 5, Vol. XIV, p. 539.

[1] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 48, Pl. VI, fig. 7 (1902).
[2] *Ibid.*, fig. 4*b*.

The large septate fragment here figured shows the characteristic, perpendicular, umbilical wall, surmounted by strong tubercles projecting outwards and downwards; also flexuous ribbing which is most conspicuous near the venter but which finishes at the rounded ventro-lateral edges with a pronounced forward sweep. The ribs are unequal, just as in Uhlig's very similar larger specimen of equal dimensions (diameter=about 135-140 mm). The venter itself is smooth and flat as in the lower part of Uhlig's fig. 2*b*, but not the upper. What little is preserved of the inner whorls (not the penultimate whorl) shows a more sulcate venter with the close and fine tubercles of the ventro-lateral edges distinctly projecting, more so than in the young "*Leopoldia*" *quadristrangulata*, Sayn[1]. The suture-line shows a much more unequally divided first lateral lobe than that of *Hoplites scioptychus*, Uhlig[2] and a shorter first lateral saddle, but otherwise is similar.

The fragment was labelled by Folgner "*Hoplites* (*Leopoldia*) aff. *leopoldi*, d'Orbigny", apparently on the strength of the unequal lateral lobe. In his unfinished description he mentioned that the ornamentation was heavy for a *Leopoldia* and that the projecting umbilical spines resembled those of *Sarasinella chichalensis*, sp. nov. I do not consider the reference to *Leopoldia* in the restricted sense justified any more than in the case of *L.* cf. *desmoceroides* (Karakasch), mentioned under No. 42. The young stages are entirely different[3] and even the suture-line is more simplified in the adult true *Leopoldia*, while ribbing and periphery are of different types. The mere fact of its being discoidal, comparatively smooth, and having the first lateral lobe divided unsymmetrically is not enough to make the present form a *Leopoldia* and its affinities are clearly with the other Neocomitids here described.

N. sp. nov. cf. *teschenensis* (Uhlig) described above (No. 61) also shows resemblance to the present form but has much broader and more distantly spaced ribs, also a subcarinate periphery. In *N.* (*?*) sp. ind. cf. *scioptychus* (Uhlig) discussed below (No. 64) the more rounded periphery is traversed by continuous close costation describing a regular gentle curve directed forwards. In *Thurmannites* (*?*) sp. ind. the ribbing is more radial and the nodes at the ventro-lateral edges form much more conspicuous rows than they do in the present form.

Blondet[4] recently again considered *N. neocomiensiformis* to be a Hauterivian representative of the Valanginian *N. neocomiensis* (d'Orbigny) and *N. nodosoplicatus* (Kilian and Reboul)[5] to be a variety of Hohenegger's species. This is probably as erroneous as Kilian's earlier association of the present form with d'Orbigny's *Amm. heliacus*[6]; and *N. neocomiensiformis* is here believed to be a forerunner of the typical *N. neocomiensis* rather than its descendant.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Chichali Pass (1).

[1] *Mém. Soc. géol. France, Pal.* No. 23, Pl. V, fig. 20 (1907).

[2] *Denksch. k. Akad. Wiss. Wien*, Vol. LXXII, Pl. IV, fig. 10 (1902).

[3] For figures of young *Leopoldia* see Baumberger (*Abh. Schweiz. Pal. Ges.*, Vol. XXXII), Pl. IV, figs. 2-3 (1906).

[4] L'Hauterivien de la région de Chambéry. *Bull. Soc. Hist. Nat. Savoie* (Chambéry), Vol. XXIII, p. 216 (1935).

[5] Sur quelques Ammonites de l'Hauterivien de la Bégude. In Kilian: Contrib. Étude Faunes paléocrét. S. E. France, II. *Mém. Explic. Carte géol. France*, p. 235, Pl. X, fig. 3, Pl. XI, fig. 4, Pl. XIII, fig. 1 (1915).

[6] Pal. Franç., Terr. Crét., Vol. I, p. 108, Pl. XXV, figs. 1-2 (1840).

64. Neocomites (?) sp. ind. cf. scioptychus (Uhlig).

(Plate XVII, fig. 3.)

A large body-chamber fragment is figured in peripheral view only because the sides are almost smooth and as featureless as those of Uhlig's[1] species which, however, at a smaller diameter (over 170 mm), has the blunt primary ribs straighter and apparently more closely spaced. The ventral projection also is greater in the Indian fragment so that the ribbing is altogether more oblique. The sides are strongly convergent and the thickness near the umbilical border was probably greater than in Uhlig's species, but the fragment is too incomplete to allow of restoration of the complete section. There is nothing left of the dorsal area and the specimen thus originally must have been of gigantic proportions.

Whether *N. scioptychus*, Uhlig, and the present form belong to the genus *Neocomites* in the restricted sense is very doubtful, but in the absence of the inner whorls it is impossible to ascertain their affinity to the similar large forms of *Subthurmannia* above described. The whorl-section of the present fragment is sufficiently similar to that of *S. occitanica* (Pictet)[2] to make it possible that it belongs to the same group of forms.

Horizon.—Neocomian (Belemnite Beds).

Locality.—682 (1).

65. Neocomites (Thurmannites ?) sp. ind.

(Plate X, figs. 2*a-c*, Plate XXII, figs. 7*a,b*.)

The small fragment figured in Plate X, fig. 2*a* fortunately retained the inner whorls (figs. 2*b,c*) and these show (in addition to a very simple suture-line) the same style of ribbing as in the adult stage, though comparatively less elegant. The ribs are single, bifurcating or bidichotomous, uniting at the umbilical edge in well-marked tubercles, especially in the young. They are less projected peripherally on the inner whorls and less flexuous, but the tabulate periphery with a very faint median depression, is essentially the same throughout. The whorl-section is similar to that of *Hoplites perisphinctoides*, Uhlig[3], except for the prominent tubercle at the umbilical edge and the higher and steeper umbilical wall of the present form. No suture-line is visible on the larger fragment which thus may have been part of the body-chamber.

Hoplites perisphinctoides which was subsequently transferred by Uhlig[4] himself to *Neocomites*, differs from the present form not only in having less prominent umbilical nodes but also in the point of branching of the ribs being higher up on the whorl-side, in addition, presumably, to a larger umbilicus. The small Himalayan example figured in Plate IX, figs. 2*a,b* as *Thurmannites* sp. ind. is probably closer to the species here described, especially in the style of ribbing and the umbilical nodes, but it has a broader periphery and the ribs are more inclined

[1] *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII, 1902, p. 57, Pl. V, figs. 1*a*, *b* as "Hoplites". Referred by Uhlig to the genus *Neocomites* in 1905 and 1910.

[2] Mélanges paléontologiques, II, p. 81, Pl. XVI, figs. 1*a-c* (1867).

[3] *Denkschr. k. Akad. Wiss. Wien.* Vol. LXXII, p. 51, Pl. VI, figs. 2*a-c* (1902).

[4] *Sitz. Ber. k. Akad. Wiss. Wien*, Vol. CXIV, p. 620, 1905; also *loc. cit.*, p. 175 (1910).

forwards. *Thurmannites kingi* (Uhlig), already referred to (Plate XIV, fig. 8), which also has a broader periphery and a less galeate whorl-section, is difficult to compare on account of size.

The form described below as *Neohoploceras* sp. nov. has almost identical ribbing in the adult, but entirely different inner whorls. It is probable, however, that there are transitions between these extremes and forms like *Neocomites ? trezanensis*, *N. ? bedoti* or *N. ? biformis*, Sayn[1] which I would refer to *Sarasinella*, are such passage-forms.

The septate fragment represented in Plate XXII, figs. 7*a,b* was labelled by Folgner "*Hoplites* (*Solgeria* em.) sp. Gruppe der *Solgeria inostranzewi*, Karakasch". The outer whorl shows ribbing essentially the same as that of the first fragment, and the inner whorls seem to be merely costate, not tuberculate. There is the same high and vertical umbilical wall, with its tuberculate edge, as in *Sarasinella chichalensis*, and it seems to me clear that the affinity of this fragment also is with the transitional group of Neocomitids above referred to. Karakasch's *Hoplites inostranzewi*[2], generally referred to the genus *Leopoldia*[3], is already smooth at a comparable diameter and has quite different inner whorls.

Horizon.—Neocomian (Belemnite Beds).

Localities.—685 (1); 687 ? (1); Makerwal Colliery (1 ?); Chichali Pass (1).

66. Neocomites (Lyticoceras ?) sp. nov.

(Plate XVII, figs. 2*a,b*; Plate XVIII, figs. 5*a,b*.)

The fragment figured in Plate XVII, fig. 2 is small but it shows the *Lyticoceras* periphery better than some larger fragments, one of which at a whorl-height of 44 mm has a thickness of 32 mm. The whorl-shape is that of Uhlig's[4] *N.* (*?*) *perisphinctoides*, but with a tabulate periphery, and a steeper and higher umbilical wall and tuberculate rim. The ribbing, however, is more like that of the new species figured by Uhlig on the same plate (fig. 1) as *Hoplites* n. sp. aff. *perisphinctoides* or his *Hoplites* n. sp. ind. (fig. 7). The ribs are mostly bifid and single, each pair uniting at the umbilical edge in small tubercles which account for the different whorl-section; but an occasional single rib which remains unattached throughout is also nodate at the umbilical edge. The ventral projection is more pronounced than in the two new species just cited, but the lateral flexuosity is similar. The ventral aspect is that of *Lyticoceras noricum* (Roemer) as figured by v. Koenen[5]. The form described above as *N.* sp. nov. ind. cf. *noriciformis* (Hohenegger MS.) Uhlig sp. has less close ribbing, shorter secondary ribs, and a wider, less Lyticoceratid periphery, with the edges scarcely angular.

The larger example, figured in Plate XVIII, fig. 5, has no single ribs and a slightly different curve, the secondary ribs being somewhat reflexed, so that the

[1] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 3 and 4, Pl. VII, figs. 20, 25; Pl. VIII, figs. 8, 9, 15, 16 (1907).

[2] Über einige Neocom-Ablagerungen in der Krim. *Sitz. Ber. k. Akad. Wiss. Wien*, Vol. XCVIII, Heft 5, p. 434, Pl. I, figs. 1-3 (1889).

[3] See Kilian, *Lethaea geognostica* fasc. 2, p. 219 (1910).

[4] *Denkschr. k. Akad. Wiss. Wien, Vol. LXXII*, P. 51, Pl. VI, fig. 2*c* (1902).

[5] Ammonitiden des norddeutschen Neocom. *Abh. k. preuss. geol. Land. Anst.* N. F. Heft 24, Pl. XXXI, fig. 5*b* (1902).

peripheral chevrons, pointing forwards, are less acute than in the smaller fragment. These differences, however, are probably not specific. The high and smooth, almost perpendicular, umbilical wall is very conspicuous in this second example and the ribs form distinct tubercles on the umbilical edge. The dimensions of the specimen are as follows:—

Diameter	80 mm.
Height of last whorl	40 %
Thickness of last whorl	27 %
Umbilicus	32 %

The width of the umbilicus is thus the same as in Uhlig's *Hoplites* n. sp. aff. *perisphinctoides*, of similar general aspect, apart from the closeness of the ribbing.

Apart from the fact that the ribbing is inclined backwards and not forwards, the fragment figured by Cohen[1] as *Hoplites noricus* (Roemer) var. *planicosta*, v. Koenen, shows some resemblance to the larger example here described, but it is not congeneric with the German original of this variety, although the inner whorls of *Lytícoceras noricum*, as figured by v. Koenen[2], are similar to those of the present form.

Horizon.—Neocomian (Belemnite Beds).

Localities.—682 (2); 690 (2); 50 (1).

67. Neocomites (Odontodiscoceras ?) sp. ind. cf. montanus, Uhlig.

(Plate XV, figs. 2*a*,*b*.)

The distinctive features of this form are the tubercles on the umbilical rim, the high and steep umbilical wall, and the feebly falcate ribbing. The latter is somewhat worn, especially towards the end which is about one-fifth of a whorl from the last suture-line. At the beginning of the last whorl, the ribs are closely spaced, curved forwards on the side and gently projected near the periphery but not nearly so flexuous as in the typical *Neocomites*. They are united at the umbilical edge in fairly prominent tubercles, and the various branches, which all seem to be long, end at the ventro-lateral edge in fine nodes. These edges, on account of the convergent sides suddenly diverging before the venter is reached, form two conspicuous, serrated ridges. The venter itself is convex and the prolongation of the small nodes at the ventro-lateral edges are sharply bent forwards towards the raised siphonal line. The greatest thickness of the subgaleate or cuneiform whorl-section is at the umbilical tubercles. The suture-line is not clearly visible, but the large first lateral lobe is unsymmetrically trifid, the outer leaflet subdividing it being much larger than the inner. The dimensions of the specimen are as follows:—

Diameter	64 mm.
Height of last whorl	48 %
Thickness of last whorl	30 (?) %
Umbilicus	25 %

[1] *Zeitschr. bulgar. geol. Ges.*, Vol. V, Heft 2, p. 164, Pl. II, fig. 14 (1933.)

[2] *Abh. k. preuss. geol. Land. Anst.*, N. F. Heft 24, p. 174, Pl. XXXI, fig. 3 only (1902).

The present form is close to *Hoplites* (*Neocomites*) *montanus*, Uhlig[1], especially the smaller paratype figured by Uhlig which has a similar if less high whorl-section. The umbilicus is also wider in that species, but the most obvious difference is in the ribbing. For in the form here described, there are no swollen primary ribs with comparatively short secondaries, but, as in Uhlig's[2] *H.* (*N.*) aff. *neocomiensis* (*non* d'Orbigny), the longer branches as well as intercalated single ribs reach to the umbilical border. By its straighter ribs, Uhlig's form (here renamed *Odontodiscoceras decipiens*, nom. nov.) is close to *O. odontodiscus*, Uhlig[3], while *N. montanus* and the present form, with their more projected ribbing and different periphery, are transitional to the true *Neocomites*, as here restricted. In the peripheral aspect there is also resemblance to certain forms of *Lyticoceras*[4], but the lateral ribbing in these is far more flexuous than in the present form. It is interesting to note, however, that the first lateral lobe of the suture-line of *L. amblygonium* (Neumayr and Uhlig)[5] is as unsymmetrical as that of the form here described, while in all the Spiti Shales species referred by Uhlig to *Neocomites*, the two leaflets in that lobe seem to be more or less equal.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Malla Khel (1).

68. Neocomites (Calliptychoceras ?) pseudovicarius, sp. nov.

(Plate XVIII, figs. 1*a*,*b*.)

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate. Whorl-section compressed, with, first, truncated, later, narrowly rounded venter and flattened sides; greatest thickness at tubercle on umbilical rim; comparatively high and steep umbilical wall. Ribs gently sigmoidal, irregularly branching, ending on ventro-lateral edge with a distinct tubercle, except on body-chamber, where the final, degenerate ribbing is continuous across the venter, with a sinus directed forwards. About eight prominent umbilical tubercles to the half-whorl. Suture-line not seen. Body-chamber just under half a whorl in length; aperture plain, with slight ventral lappet.

Measurements.

Diameter	82 mm.
Height of last whorl	41 %
Thickness of last whorl	27 %
Umbilicus	30 %

Remarks.—This form seems to be allied to the (less closely ribbed) *Hoplites ottmeri*, Neumayr and Uhlig[6], later referred by Uhlig[7] to the genus *Acanthodiscus*; but it is probable that the affinities of the species here described are rather with

[1] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 249, Pl. XC, figs. 1*a-c* (holotype), 5*a-c* (1910).

[2] *Ibid.*, p. 246, Pl. LXXXVIII, figs. 3*a-c*.

[3] *Ibid.*, p. 256, Pl. LXXXV, figs. 1-3.

[4] Compare *e.g.*, *L. regalis* (Bean) in Pavlow (*loc. cit.*, Argiles de Speeton, Pl. XVII(X), figs. 1-2) (1892).

[5] See in Zittel's Text-Book of Palaeontology (first English edition by Eastman), p. 536, text-fig. 225 (1900). Copied from Zittel's Handbuch der Palaeontologie, Vol. I, Lief. 7, p. 476, text-fig. 663 (1884), and originally from Neumayr and Uhlig, *Palaeontographica*, Vol. XXVII, Pl. XXXVI, figs. 1, 1*b-c* (1881).

[6] *Palaeontographica*, Vol. XXVII, p. 166, Pl. XXXV, figs. 1, 1*a-c* (1881).

[7] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 166 (1910).

those Indian forms, described by Uhlig as *Neocomites*, for which I proposed the name *Calliptychoceras*. It is true that the ribbing of the new form is, first, less flexuous and, then, more degenerate, than in the typical *C. calliptychus* (Uhlig)[1] or the closely allied *C. walkeri* (Uhlig)[2]; but the rounding of the periphery and the presence of strong umbilical tubercles indicate that the two stocks are probably closely related, although the earlier whorls of the Salt Range form could also be compared to that Himalayan species, apparently of *Odontodiscoceras*, which was described by Uhlig as *Neocomites* aff. *neocomiensis* (*non* d'Orbigny)[3]. They are similar to the form figured in Plate IX, fig. 2 as *Thurmannites* (?) sp. ind.

Hoplites neocomiensiformis (Hohenegger MS.) Uhlig[4] differs from the present form in its more numerous umbilical tubercles and the coarser ribbing of its earlier stages. *Hoplites vicarius*, Vacek[5], which was referred by Uhlig[6] to the genus *Neocomites*, shows somewhat similar proportions, also degeneration of the ribbing, like the form here described, but it is probably only distantly related. For it was identified with *Amm. cryptoceras*, de Loriol, *non* d'Orbigny, and neither this form nor the true *Lyticoceras cryptoceras* (d'Orbigny) or some Escragnolles examples in the British Museum (Nos. C.2440, C.2750, both labelled *Amm. cryptoceras* but widely different) show resemblance to the Salt Range species. This may also be compared with the form described above (No. 35) as *Subthurmannia* (Gen. nov.?) *pseudopunctata*, sp. nov., which has prominent tubercles round the umbilical edge and a steep and high slope. But the differences in costation, width of the umbilicus and in the periphery are considerable; and a certain family resemblance of all the Neocomitidae to the ancestral *Subthurmannia* and its allies is to be expected. It is probable, however, that *S.* (Gen. nov.?) *pseudopunctata* is a representative of a new, transitional stock.

A fine second example, received after the above was already in type, confirms the distinctness of this species. Being much larger than the holotype the early part of the outer whorl of this paratype (No. 16616) is already as coarsely ribbed as the final portion of the type, and the body-chamber, up to the identical aperture, is consequently even more robust. The dimensions (120 —·43 —·28 —·28) also agree well, so that the differences are only apparent.

Horizon.—Neocomian (Belemnite Beds).

Localities.—700 (1) and Baroch Gorge, No. K 40/158*a* (1).

Genus: KILIANELLA, Uhlig, 1905.

69. KILIANELLA ASIATICA, sp. nov.

(Plate XIV, figs. 2*a*,*b*.)

Diagnosis.—Subplatygyral, subpachygyral, subangustumbilicate. Whorl-section slightly compressed, with bulging sides, greatest thickness at middle of

[1] Fauna of the Spiti Shales, fasc. 2, p. 251, Pl. LXXXVII, figs. 2*a-c* (1910).
[2] *Ibid.*, p. 253, Pl. LXXXVII, figs. 3*a*, *b*.
[3] *Ibid.*, p. 246, Pl. LXXXVIII, figs. 3*a-c*.
[4] *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII, p. 54, Pl. III, figs. 1-2 (1902).
[5] *Jahrb. k. k. geol. Reichsanst.*, Vol. XXIX, p. 1739, Pl. XIX, figs. 11*a*, *b* (1879).
[6] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 175 (1910).

side, comparatively wide, sulcate venter and high and steep umbilical wall. Ribs as in *K.* "*pexiptycha*" (Uhlig)[1] but more flexuous, with more triplicate ribs; subtuberculate at point of branching. Suture-line comparatively simple, with almost symmetrical trifid first lateral lobe (Plate XIII, fig. 4, enlarged ×2½ and somewhat diagrammatic).

Measurements.

Diameter	43 mm.
Height of last whorl	40 %
Thickness of last whorl	35 %
Umbilicus	34 %

Remarks.—This form is very close to the Himalayan example attached by Uhlig[1] to his species *K. pexiptycha*, but I should not now give the form a new name if I did not feel convinced that Uhlig's[2] original, strongly constricted Rossfeld form, with finely ribbed inner whorls, is specifically different from the Spiti Shales example. This is not so well preserved as the figure suggests, judging by a cast in the British Museum (Nat. Hist. No. C.14092); and it is probable that when more specimens become available the Himalayan form will be attached to *K. asiatica*. The true *K. pexiptycha* is closer to d'Orbigny's[3] *Amm. roubaudianus*, first figured by Kilian[4] and has indeed been united with that species, although Sayn[5], for example, kept them apart and figured as *Thurmannia* (*Kilianella*) cf. *pexiptycha* an example which is flexicostate like *K. asiatica*, but which is neither the Himalayan nor the Teschen *K. pexiptycha* of Uhlig[6]. The latter, with many simple ribs, in fact, is closer to the form described below as *K. besairiei* than to *K. asiatica*.

Sayn's[7] *K. roubaudi* (d'Orbigny) is perhaps less close to the present species than the same author's[8] *K. ischnotera*, but both are less flexiradiate. *K. leptosoma* (Uhlig)[9], with its high and flat whorls, lacks the thickening at the point of bifurcation of the ribs which are also much straighter than in *K. asiatica*.

The early Madagascan form of *Kilianella* figured in Plate X, figs. 5*a*,*b* and formerly recorded by myself[10] as *K. pexiptycha* (Uhlig) is more compressed than *K. asiatica*, and it has a wider umbilicus, the dimensions being as follows:—

Diameter	48 mm.
Height of last whorl	35 %
Thickness of last whorl	30 %
Umbilicus	44 %

[1] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 229, Pl. LXXXII, figs. 2*a-c* (1910).

[2] Zur Kenntnis der Cephalopoden der Rossfeld-Schichten. *Jahrb. k. k. geol. Reichsanst.*, Vol. XXXII, p. 389, Pl. IV, figs. 4*a*, *b* (1882).

[3] Prodrome de Paléontologie, Vol. II, p. 64, étage 17, No. 41 (1850).

[4] Sur quelques fossiles du Crétacé inférieur de la Provence. *Bull. Soc. géol. France* (III), Vol. XVI, p. 679, Pl. XVII, figs. 2-3 (1888).

[5] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 3-4, p. 49, Pl. III (VII), fig. 15 (1907).

[6] *Denkchr. k. Akad. Wiss., Wien*, Vol. LXXII, Pl. IV, fig. 5 (said to be typical) (1902).

[7] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 3-4, Pl. VI(X), fig. 10 (1907).

[8] *Ibid.*, p. 47, Pl. VI(X), figs. 1*a*, *b*.

[9] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 232, Pl. LXXXII, figs. 3*a*, *b* (1910).

[10] *Pal. Ind.*, N. S., Vol. IX, Mem. 2, Pt. 6, p. 824 (1933).

It has much sharper ribbing than any of the forms of *Kilianella* so far discussed and the secondaries are scarcely projected, features that support the derivation of *Kilianella* from the primitive *Berriasella* (*privasensis* group), in Uhlig's[1] sense. But the undoubted affinity with *Neocomites*, especially the *platycostatus* group, which has been stressed by French authors, and even with such aberrant groups as *Neohoploceras* (see p. 105), shows that the evolution of the closely interrelated Neocomitidae from the earlier Berriasellidae took place along many parallel lines.

The straight-ribbed form of *Kilianella* figured and described by Pervinquière[2] as *K. pexiptycha*, Uhlig (*K. roubaudiana*, d'Orbigny sp.) and considered to be a passage-form to the (doubtful) *Amm. asperrimus*, d'Orbigny, may belong to the same species as the early Madagascan example here described. It is interesting to note that Kilian[3] also recorded a transition from *Berriasella privasensis* to *Kilianella roubaudiana* from the *boissieri* zone (Infra-Valanginian), but *Kilianella* comes in in force only in the Valanginian (Valanginien moyen of Kilian) while *K. pexiptycha* is associated in the Rossfeld beds with a fauna that includes Hauterivian genera (*Oosterella*, *Holcodiscus*, *Crioceras*).

Horizon.—Neocomian (Belemnite Beds).

Localities.—687 (1); 682 ? (1).

70. Kilianella cf. pexiptycha (Uhlig).

(Plate XXII, figs. 1-2.)

There is a form close to *K. asiatica*, sp. nov. which differs chiefly in greater inflation but which is represented only by poorly preserved examples. One, the original of Plate XXII, fig. 1, was described by Folgner as *K.* cf. *pexiptycha* and he stated that he did not definitely identify it with Uhlig's species (as represented by the Spiti Shales example referred to under *K. asiatica*) because it showed more numerous bifurcating ribs and flatter whorl-sides. The second difference certainly is noticeable. The high and steep umbilical wall is costate, with the ribs subtuberculate where they pass rather abruptly on to the side, and combined with the considerable inflation these features give the present form a distinctive aspect, which certainly separates it from the Teschen examples of *K. pexiptycha* as well as from *K. roubaudiana* (d'Orbigny). As regards the bifurcation of the ribs, it may not differ from that of Uhlig's Himalayan example, for the Salt Range specimen is not only poorly preserved but has been developed (and not improved by the preparation). Its dimensions are:—

Diameter	47 mm.
Height of last whorl	40 %
Thickness of last whorl	42 %
Umbilicus	34 %

A second specimen of similar dimensions, labelled *K.* aff. *pexiptycha*, seems to have closer costation than the first, but again the preservation makes it

[1] *Op. cit.*, Fauna of the Spiti Shales, fasc. 2, p. 170 (1910).
[2] Pal. Tunisienne, I, p. 184, Pl. VII, figs. 29*a*, *b* (1907).
[3] *C. R. Assoc. Franç. Av. Sci.*, Congrès de Lille, p. 490 (1909) (1910).

difficult to appraise the importance of this difference; for, unlike the figured example, this second specimen has not had the ribs carved out so as to resemble single ribs. At least one of them bifurcates lower down the whorl-side than any of Uhlig's Himalayan type, without, however, reaching the umbilical edge. This second example may also have a slightly smaller umbilicus than the first.

A third example, more incomplete, but again of similar dimensions, is figured in Plate XXII, figs. 2*a*, *b*. It was labelled by Folgner *Hoplites* (*Kilianella*) cf. *asperrimus* (d'Orbigny). The ribbing is essentially the same as in Uhlig's Spiti Shales form and the differences from the other two examples may be only apparent; but the nodes at the point of bifurcation of a few of the ribs seem unusually prominent. This may again be due to preparation, the greensand matrix being extremely difficult to remove from these corroded fossils. But even if genuine, the tuberculation probably was not more pronounced than it is in what Uhlig[1] called the typical form of *K. pexiptycha* (1902, *non* 1882). In his description Folgner considered this "well-sculptured" specimen to represent a new species and compared it chiefly to *K. asperrima* as represented by Uhlig's[2] Teschen Shales examples. In view of the absence of the inner whorls, this comparison rests on the presence of the lateral nodes and since d'Orbigny's original *Amm. asperrimus* is altogether doubtful, I think it preferable to include this example also in *K.* cf. *pexiptycha*. This is not disputing Folgner's contention that the genus *Kilianella* may be represented in the Salt Range by five distinct species. But since only the *pexiptycha* group is here left in *Kilianella* s. s. and since the new genus *Neohoploceras* is now used for Folgner's second group, while I have been able to add several new forms, the numbers naturally disagree.

Horizon.—Neocomian (Belemnite Beds). This species may be of Lower Valanginian age, judging by its associates in the faunas of the Upper Teschen Shales and of various localities in the eastern Balkans. In Madagascar, fragments referred to this species, have been found in the Infra-Valanginian[3], but they are not well enough preserved to be definitely identified. The Hauterivian *Thurmannites* (*Kilianella*) *pexiptychus* of Kilian and Reboul[4] must surely be based on a misidentification.

Locality.—Chichali Pass (3).

71. Kilianella besairiei, sp. nov.

(Plate XVI, figs. 4*a*,*b*.)

1936. Cf. *Thurmannites* sp. Besairie, *loc. cit.* (*Mém. Acad. Malgache*, fasc. XXI), p. 138, Pl. XXIV, fig. 13.

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate to sublatumbilicate. Whorl-section compressed, subrectangular, with greatest thick-

[1] *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII, Pl. IV, fig. 5 (1902).
[2] *Ibid.*, figs. 8-9.
[3] See Besairie (*Mém. Acad. Malgache*, fasc. XXI), p. 137, Pl. XXIV, fig. 16 (1936).
[4] *Mém. Explic. Carte géol. France*, pp. 259, 264 (1915).

ness at middle of gently convex sides and with tabulate venter. Umbilical slope rounded, without distinct edge. Ribs first single and bifurcating, with occasionally a trifurcating rib (having the low branch in front and the high fork behind) followed by a constriction which marks a change in the direction of the ribbing. Later the ribs become more flexuous and more markedly reclined, the secondaries tend to separate from their primary stems and to become long and thickened towards the ventral edge. The obliquely placed tubercles at the ventro-lateral edges are of very unequal size and the periphery between the two rows may be sulcate, plane or subcarinate, according to the prominence of the tubercles. Suture-line comparatively simple, with asymmetrically trifid first lateral lobe and outer leaflet in this lobe much larger than inner.

Measurements.

Diameter	50 mm.
Height of last whorl	40%
Thickness of last whorl	26%
Umbilicus	34%

Remarks.—The holotype is entirely septate, but the body-chamber fragment figured in Plate XVI, figs. 5*a*, *b*, although from Madagascar, may be taken to show the ornamentation of the final stage. All the ribs are then single, almost equal and the ventral area is tabulate, with the ventro-lateral edges and the median pseudo-carina on the same level. Two similar but smaller fragments from locality 685 confirm the identification and are interesting because of their resemblance to *Neocomites platycostatus*, Sayn, above referred to (p. 84). The difference, in fact, is chiefly a difference of involution and it is possible that direct transitions may yet be found. One of the fragments is septate and again clearly shows the asymmetrical first lateral lobe, resembling that of *Neocomites neocomiensis* (d'Orbigny) as figured by Franke[1].

K. pexiptycha, Uhlig (1902[2] *non* 1881), already referred to under the last heading, is closer to the present species than any of the other forms of *Kilianella* so far known. The original of Uhlig's fig. 5, especially, described as typical (but, to me, specifically different from the original *K. pexiptycha*) though crushed, has the same flattened ribs. They are less broad and distant, however, and the whole ammonite is somewhat less extreme than the present form. Another example with similar ribbing was figured by Uhlig[3] as *Hoplites campylotoxus*, but is apparently transitional between that species and *Hoplites pexiptychus* of the same plate. It differs from the form here described chiefly in having umbilical tubercles. Its ribbing also is less coarse and hence the ventral aspect presumably was different.

Horizon.—Neocomian (Infra-Valanginian), Belemnite Beds.

Localities.—687 (1); 685 ? (2); 692 ? (1); 682 ? (1).

[1] *Jahrb. preuss. geol. Land. Anst.*, Vol. XXXIX, p. 487, text-fig. 1 (1920).
[2] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 41, Pl. IV, figs. 4-7 (1902).
[3] *Ibid.*, p. 49, Pl. IV, fig. 3 only.

72. KILIANELLA ? ("ACANTHODISCUS") sp. nov. cf. LAMBERTI (Sayn).

(Plate XVI, figs. 3*a*, *b*.)

A fragmentary specimen seems to show resemblance both to species figured by Sayn[1] as *Kilianella superba* and *Acanthodiscus lamberti* and to forms here included in *Sarasinella*. Unfortunately, the inner whorls are missing, so that the generic identification must remain uncertain. The dimensions of the specimen are as follows:—

Diameter	52 mm.
Height of last whorl	33%
Thickness of last whorl	37%
Umbilicus	46%

The whorl-section is octagonal, the great thickness being due to the very prominent lateral tubercles, as the ventral sulcus is caused by the peripheral tubercles. The umbilical slope is high, but well rounded. The ribs vary greatly; some are short, some long, feeble or strong, provided with umbilical, lateral and ventral tubercles, thickened or unchanged at the periphery. All the ribs are projected ventrally but owing to the unequal development of the outer tubercles the ventral aspect suggests unusual irregularity. On the penultimate whorl there is already one strong rib, with a lateral and umbilical tubercle. The suture-line is not well exposed, but the first lateral lobe can be seen to be asymmetrical.

While *K. superba* (Sayn) has similar, if less extreme, ornamentation, *Acanthodiscus lamberti*, Sayn, does not show bifurcation of the strong ribs at the lateral tubercle. This may seem a small point, considering the great irregularity of the ribbing, but as Sayn's type example is much smaller than the Indian form, the two cannot belong to the same species, even if the differences in the ventral aspect be ignored. *Kilianella lucensis* (Sayn)[2] which connects *K. superba* and the present form with the more typical species of *Kilianella*, is not unlike the Salt Range form in ventral aspect, since it also has some thickened ribs at irregular intervals. The resemblance to certain Spiti Shales forms of *Neocosmoceras* (*octagonus* group of "*Acanthodiscus*") is not very close, while even the forms of *Sarasinella* that retain the tri-tuberculation to a comparatively large size (*e.g. S. eucyrta*, Sayn sp.[3]) are never so extreme as the present example. Both *Protacanthodiscus* and the true *Acanthodiscus* have an entirely different ventral aspect.

It is possible that the fragment figured in Plate XXII, figs. 6*a*, *b* represents the outer whorl of a form like the present, for it is certainly distinct from any of the Salt Range forms here described, except possibly *Neohoploceras baumbergeri* sp. nov. The specimen was labelled by Folgner "*Hoplites* (*Kilianella*) sp. ind. aff. n. sp. ind., Uhlig[4] (Spiti)", but the resemblance is not very close. For there is a distinct ventral groove in the present form and the course of the

[1] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, Pl. VIII(IV), figs. 18*a*, *b* and 11*a*, *b* (1907).
[2] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 50, Pl. X(VI), figs. 13, 17-20 (1907).
[3] *Ibid.*, p. 36, Pl. VIII(IV), figs. 3-5.
[4] See Uhlig, *op. cit.*, p. 232, Pl. LXXXII, figs. 4*a-c* (1910).

ribs is different and more flexuous; moreover, there are only three intermediate ribs between the two tuberculate ribs, one of which bifurcates. This suggests comparison with the forms of *Kilianella* figured by Sayn and already referred to. *Neohoploceras baumbergeri*, which is also similar, has a much more rounded whorl-section, depressed, not compressed, and, judging by the width of the dorsal area of the fragment here described, even its earlier whorls were comparatively flat.

Himalayites ? (Gen. nov.?) sp. ind. (Plate VII, fig. 1), while showing the peripherally projected costation of *Kilianella*, has a wider venter, a broader peripheral groove and the terminations of the ribs on the two sides (well separated) make a more obtuse angle than they do in the example here discussed.

Another small fragment, apparently not dealt with by Folgner, is too incomplete and too much worn on one side to be definitely identified, but it may also be included here. It is too coarsely ornamented to be referred to *N. baumbergeri*, sp. nov., with which it had been included under the same label.

Horizon.—Neocomian, Belemnite Beds.

Localities.—687 (1); Chichali Pass (1).

Genus: SARASINELLA, Uhlig, 1905.

73. SARASINELLA UHLIGI, sp. nov.

(Plate XII, fig. 5; Plate XIV, figs. 1*a*, *b*; Plate XXI, figs. 5*a*, *b*, 6.)

1933. *Hoplitides (Thurmannites) trezanensis*, Sayn; Spath, *loc. cit.* (Pal. Indica, N. S., Vol. IX, No. 2, fasc. 6), p. 802.

Diagnosis.—Subplatygyral, subleptogyral, subangustumbilicate. Whorl-section compressed, with flattened sides and tabulate venter; greatest thickness at umbilical rim. High and almost perpendicular umbilical wall. Ribs first irregular, comparatively coarse and provided with tubercles at umbilical rim and at middle of whorl-side, the latter appearing to lie on umbilical wall of next succeeding whorl. On outer volution, only inner tubercles remain, and the projected peripheral terminations of the ribs are not strongly but unequally tuberculate, with occasional constrictions. Irregular lateral ribbing tending to become effaced on middle of side at later stages. Suture-line fairly complex, with very asymmetrical first lateral lobe and short second lobe.

Measurements.

		var. *elegans*, nov. (Plate XXI, fig. 5).
Diameter	68 mm.	82 mm.
Height of last whorl	45%	46%
Thickness of last whorl	29%	34% (?)
Umbilicus	27%	27%

Remarks.—The holotype is entirely septate and towards the end is much like the form (see p. 79) provisionally attached to *Thurmannites pertransiens* (Sayn), with a very similar suture-line. *S. ambigua* (Uhlig)[1] which was correctly

[1] *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII, p. 45, Pl. VI, figs. 3*a-c* (1902).

called the type of *Sarasinella* by Lemoine[1], also has an asymmetrical first lateral lobe, but does not lose its lateral ribbing, even at a much larger diameter, and there are other differences, such as in proportions and peripheral aspect. *S. desori* (Pictet and Campiche)[2], with a somewhat similar though less rectangular outer whorl and a comparable suture-line,[3] has different inner volutions; if Kilian[4] was correct in identifying the *desori* group with *Sarasinella*, the original drawing cannot be accurate, although Baumberger equally omitted to refer to lateral tubercles on the inner whorls.

S. varians, Uhlig[5] with similar though much coarser inner whorls than *S. uhligi* differs considerably in whorl-shape, and *S. subspinosa*, Uhlig[6] also is much less compressed and has a more rounded venter. I am figuring a small Spiti Shales example in Plate XVI, figs. 2*a*, *b*, to show the close affinity of this form with *Neocomites* ? *longi* and *N.* ? *trezanensis*, Sayn[7]. These forms should also be referred to *Sarasinella*, but not species like *Neocomites teschenensis* (Uhlig). I previously (1933) identified the Salt Range form here described with *S. trezanensis*, but I had not then seen the excellent illustration in Baumberger[8]. Judging by a specimen from Barrème, Basses Alpes, in the Astier Collection (B. M. No. 73462*a*) the French form has stronger ribbing, a smaller umbilicus and a more convex whorl-side than *S. uhligi*.

The example figured in Plate XXI, fig. 5, and four fragments (including Plate XXII, fig. 4) bore a label by Folgner "*Solgeria indica, mihi*", but his description of that species refers to two fragments which were labelled "*Solgeria chichalensis*". The form is so close to the holotype of *Sarasinella uhligi* that specific separation is impossible. The sides are slightly less flat, the ribbing is closer and less effaced at the middle of the sides, and the constrictions are more conspicuous than in the holotype, but the suture-line, ventral aspect and general appearance are so similar that I am keeping this form distinct merely as a variety and propose for it the name var. *elegans*, nov., Solger's MS. name obviously being inapplicable. The inner whorls figured in Plate XXI, figs. 6*a*, *b* probably also belong to the present species. Together with three more fragments, apparently of the typical form as well as the var. *elegans*, they were among a set of eleven specimens labelled *Solgeria* aff. *leenhardti*. The lateral tubercle on the inner whorls is very feeble on the figured example but stronger in others; as in the case of *S. campylotoxa* (Uhlig) I can see in this no cause for exclusion from the genus *Sarasinella*. The close affinity of all forms of *Sarasinella* with *Neocomites* is evidenced by the fact that *N. neocomiensis* (d'Orbigny) itself, according to Sayn[9], may occasionally show tuberculiform swellings on the sides of the inner whorls, so that the identification of passage-forms between the two genera may have to be based on the characters of the adult whorls.

[1] Géologie de Madagascar, p. 180 (1906).

[2] *Mat. pal. Suisse*, Sér. II, Pt. 2, p. 246, Pl. XXXIII, fig. 4 (1860).

[3] See in Baumberger, (*Abh. Schweiz. Pal. Ges.*, Vol. XXXII), p. 62, text-fig. 39 (1905).

[4] Lethaea geogn., fasc. 2, p. 223 (1910).

[5] *Op. cit.*, (Fauna of the Spiti Shales, fasc. 2), p. 238, Pl. LXXXI, figs. 3*a-d* (1910).

[6] *Ibid.*, p. 239, Pl. XC, figs. 4*a-c*.

[7] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, Pl. VIII(IV), fig. 2; Pl. VII(III), fig. 25 (1907).

[8] Beschreibung Zweier Valangien-Ammoniten, nebst Bemerkungen über die Fauna des Gemsmättli-Horizontes von Sulzi im Justital. *Eclogae geol. helvet.*, Vol. XVIII, No. 2, p. 307, Pl. VIII, figs. 2-4 (1923).

[9] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, p. 63 (1907).

Horizon.—Valanginian, Belemnite Beds.

Localities.—Chichali Hills (B. M. No. C.94, transferred from Indian Museum, 1880); Makerwal Colliery (2 doubtful fragments); Chichali Pass (9).

74. Sarasinella chichalensis (Folgner MS.) sp. nov.

(Plate XXI, figs. 3-4.)

Diagnosis.—Subplatygyral ,subleptogyral, subangustumbilicate. Whorlsection subgaleate, with greatest thickness at umbilical tubercle, high and perpendicular umbilical wall and tabulate (first sulcate) periphery. Sides flattened or even subconcave on inner half. Ribs irregular, single, bifurcating or bidichotomous, flexuous, and springing from high inner tubercles, projecting first sideways and then more and more downwards. Lateral spines to at least 30 mm. diameter. Fine irregular striae of growth between the ribs and occasional constrictions, marked by preceding stronger ribs. Lateral ribbing becoming indistinct at larger diameters and cast then almost smooth. Peripheral terminations of ribs also far less marked than in young. Suture-line very complex, with first lateral lobe strongly asymmetrical.

Measurements.

Diameter	70 mm.
Height of last whorl	44%
Thickness of last whorl	33%
Umbilicus	27%

Remarks.—As type of this species is taken the original of Plate XXI, fig. 3, which is believed to be identical with the inner whorls of the larger (and still septate) example illustrated in fig. 4, although the latter is very slightly less closely costate. Folgner had labelled both examples *Solgeria chichalensis*, but in his description the holotype was named "*S. wilfriedi*" and the larger example "*S. indica*", while they apparently were all dealt with again under still different names, notably *S. karakaschi* (Uhlig), *S.* sp. ex aff. *arnoldi* (Pictet and Campiche), *S. douannensis* (Baumberger), *S.* sp. ex aff. *syncostata* (Baumberger), etc. Some of these, no doubt, were meant for fragments or small examples here referred to other species of *Sarasinella* and *Neohoploceras* and it is possible not only that some of the labels became misplaced, but that I have not received all the specimens described by Folgner. In any case his descriptions stress the affinity of the present form and its allies with the Crimean species *Hoplites inostranzewi*, Karakasch, and *H. karakaschi*, Uhlig (=*H. desori*, Karakasch *non* Pictet and Campiche). It is probable that *S. chichalensis* is related to these forms, but there can be no doubt that it is far closer to the form above described as *S. uhligi*. That species, in fact, differs from the form here dealt with merely in being less coarsely ribbed. Unfortunately there is no comparable adult stage. *S. chichalensis* must have grown to a large size, but it is improbable that some of the smooth fragments previously referred to have been incorrectly identified. In *Subthurmannia* especially, the rounded and almost untuberculate umbilical edge is always easily recognised.

A small example labelled "*Hoplites* (*Solgeria*) nov. spec. (with relations to *S. leenhardti*, Kilian)" probably belongs to the present species. Unlike the holotype it does not show lateral spines but this appears to be due merely to its defective preservation.

Horizon.—Neocomian, Belemnite Beds. Like many of Folgner's examples of "*Solgeria*", these specimens were also labelled "basal Hauterivian".

Locality.—Chichali Pass (3).

75. Sarasinella (?) sp. ind. nov. ?

(Plate XIV, figs. 9*a*, *b*.)

Compare: 1936. *Hoplitoides gignouxi*, Besairie, *loc. cit.* (Mém. Acad. Malgache, fasc. XXI), p. 143, Pl. XIV, figs. 18-19.

An entirely septate example is somewhat weathered and it is also too small to be given a new name, but it cannot be attached to any species known to me except *S. gignouxi* (Besairie), of different dimensions, and may thus be described separately. The dimensions are as follows:—

Diameter	49 mm.
Height of last whorl	39%
Thickness of last whorl	33%
Umbilicus	36%

The whorl-section is compressed, with gently convex sides, a comparatively broad, subtabulate venter, and the greatest thickness at about the middle of the side. The umbilical wall is high and vertical, but the edge is well rounded. The ribs are flexuous and they increase in thickness towards the venter where they are nodate and only slightly projected. On the outer whorl the ribs are single and bifurcating and the point of branching is unusually low. On the inner whorls this point, then much higher, is strongly tuberculate, and there seem to have been umbilical tubercles, at least on some of the ribs. This type of ribbing alone would seem to point to affinity of the present form with *Sarasinella*, in which, as Uhlig has shown, the development is from tuberculate to costate and not the reverse, as in *Acanthodiscus* (*sensu lato*).

In ribbing the present form seems to resemble the forms of *Neocomites* figured by Sayn[1] as *N. teschenensis* and *N. platycostatus*, more than his species with tuberculate inner whorls, referred to under the form last described and here included in the genus *Sarasinella*. But the ribbing is in reality quite distinctive. *Hoplites heteroptychus*, Pavlow[2], a species which I[3] formerly referred to *Hoplitides*, also is not closely related, for apart from the obvious differences in ribbing, the involution in the present form is very slight, causing an almost crioceratid type of coiling. The small ammonite referred by v. Koenen[4] to Pavlow's species is still less comparable; and if the comparison to a tuberculated "variety" of

[1] *Mém. pal. Soc. géol. France*, Vol. XV, fasc. 2, Pl. VIII(IV) (1907).
[2] *Op. cit.*, Argiles de Specton, p. 109, Pl. XI, fig. 22 (1892).
[3] *Geol. Mag.*, Vol. LXI. p. 76 (1924).
[4] *Abh. k. preuss. geol. Land. Anst.*, N. F., Heft 24, p. 217, Pl. VII, figs. 10*a-c* (1902).

"*Hoplites*" *thurmanni* figured by Kilian[1] is apt, is closer to *S. uhligi* than to the present form. Von Koenen's[2] *Hoplites* cf. *curvinodus* (Neumayr and Uhlig) has similar ribbing and evolution, but the innermost whorls are not tuberculate and the ventral aspect is different, so that this species, apparently a *Distoloceras*, like Phillip's original *D. curvinodus*, is not closely related to *S.* sp. nov. ? The general resemblance in lateral aspect to Speeton and North German forms of *Lytoceras* is probably due partly to the weathering, and the peripheral aspect alone prevents closer comparison. But the ribbing of the present form also differs so much from that of the typical *Sarasinella* figured in Pl. XVI, figs. 2*a*, *b* that the reference to that genus on the basis of tuberculation alone must be questioned.

The example figured in Pl. XXII, fig. 8, is malformed, the ventro-lateral edge being distinctly marked, as in *S.* aff. *campylotoxa* (Uhlig), on one side, but rounded on the other (the figured side) where the untuberculate ribs pass over the border with merely a forward bend, and reach to the siphonal line. At the same time the side is rather smooth (the unfigured side is corroded); but the indistinctness of the ribbing and of the constrictions may be due, at least partly, to over-preparation. The complex suture-line, however, though not clearly traceable, does not seem to be greatly affected by wear. In the absence of the earlier whorls it is impossible to identify this fragment which must have belonged to a fairly evolute form; but it may well indicate the existence, in the Salt Range fauna, of yet another species of *Sarasinella*, allied to the present form and to *S.* aff. *campylotoxa*, described below. The example was labelled by Folgner "*Favrella* nov. sp. belonging to a group which shows leanings towards *F. stantoni*", but there are no MS. notes to elucidate this identification and the specific name was not used for any of the Salt Range species of *Subthurmannia* that were referred to *Favrella* by Folgner. It is probable that he did not notice that the example was malformed.

Horizon.—Neocomian, Belemnite beds.

Localities.—687 (1); Chichali Pass (1 ?).

76. Sarasinella aff. campylotoxa (Uhlig).

(Plate XXII, figs. 5*a*, *b*.)

1902. *Hoplites campylotoxus*, Uhlig; *loc. cit.* (*Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII), p. 49, Pl. IV, fig. 2 (holotype); 1*a*, *b*; 3.

1905. *Hoplites campylotoxus*, Uhlig; *loc. cit.* (*Sitz. Ber. k. Akad. Wiss. Wien*, Vol. LXIV, 1), p. 619.

1906. *Hoplites* (*Sarasinella*) *campylotoxus*, Uhlig; Lemoine: Études géologiques dans le Nord de Madagascar, pp. 174, 175, 180.

1907. *Thurmannia campylotoxa* (Uhlig) Sayn, *loc. cit.* (*Mém. Soc. géol. France, Pal.*, No. 23), p. 42, Pl. V, fig. 12.

1907. *Hoplites* (*Neocomites*) aff. *campylotoxus*, Uhlig; Toula: Die Acanthicus Schichten im Randgebirge der Wiener Bucht bei Giesshübl. *Abhandl. k. k. geol. Reichsanst*, Vol. XVI, Heft 2, p. 87, Pl. X, fig. 5.

[1] *Bull. Soc. Statist. Isère.* Pl. IV, figs. 2-3 (1892).

[2] *Abh. k. preuss. geol. Land. Anst.*, N. F., Heft 24, p. 189, Pl. XIII, figs. 7*a*, *b* (1902).

1910. *Hoplites campylotoxus*, Uhlig; *op. cit.* (Fauna of the Spiti Shales, fasc. 2), p. 173.
1910. *Hoplites* (*Thurmannia*) *campylotoxus*, Uhlig; Kilian, *loc. cit.* (Lethaea geognostica, fasc. 2), pp. 182, 218.
1930. *Thurmannia campylotoxa* (Uhlig) Roch, *op. cit.* (Études géologiques Maroc occidental), p. 306.
1932. *Thurmannia campylotoxa* (Uhlig) "var. with tubercles". Ackermann: Die Unterkreide im Ostteil des Preslav-Sattelsystems (Ostbulgarien). *Abh. Sächs. Akad. Wiss., Leipzig, Math.-Phys. Kl.*, Vol. XLI, No. 5, p. 42.
1933. *Thurmannia* (*Kilianella*) *campylotoxa* (Uhlig); Cohen: Geologie des Derwent-Dervis Gebirges. *Zeitschr. Bulg. Geol. Ges.*, Vol. V, Heft 2, p. 162, Pl. II, fig. 11.

The figured fragment was labelled and described by Folgner as "*Hoplites* (*Sarasinella*) *campylotoxa*, Uhlig"; and since he worked under the distinguished author, the identification may be taken as having been approved by Uhlig. Fortunately the inner whorls are comparatively well preserved (on the side not figured) and it can be seen that there are prominent lateral tubercles, at least to a diameter of about 15 mm. Uhlig's original from the Teschen Shales does not seem to have such a trituberculate early stage, but since the ammonites in the Teschen Shales are always crushed the preservation of the delicate spines can never be satisfactory. In any case *S. campylotoxa* and especially the Salt Range form here figured are undoubtedly closer to *Sarasinella* than to the involute, high-whorled *Neocomites*; and since the host of forms that have been included in the latter genus are very diverse, any subdivision, however artificial, seems preferable to indiscriminate lumping.

The figured fragment is septate and well shows the suture-line which has long and slender external and first lateral saddles, a short external lobe, a deep and almost regularly trifid first lateral lobe, and a small second lateral saddle, with two small auxiliaries on the steep umbilical slope. This suture-line is essentially the same as that of *e.g.*, *S. chichalensis*, sp. nov. and shows general agreement with that of *S. ambigua* and *S.* aff. *ambigua* as figured by Uhlig.[1]

A second fragment, labelled *Sarasinella* sp. nov., is less well preserved and seems to have a slightly broader external saddle and a less deep first lateral lobe; but this is due to interlocking successive suture-lines having been confused by Folgner when he painted the suture-line in. As there is no description I can only assume that he separated this form from *S. campylotoxa* on these supposed differences in the suture-line. Ornamentation and whorl-shape are identical and both this fragment and the figured example seem to me indistinguishable from Uhlig's original (fig. 2).

A third fragment, labelled "*Solgeria leenhardti* (Kilian)" is slightly larger and yet more finely and closely ribbed, whereas in the type the ribbing becomes more distant with age. The peripheral terminations of the ribs, however, are more inclined forwards than in the other fragments labelled *Solgeria leenhardti* and referred to under *Thurmannites* (?) sp. ind. (No. 58). Since the third fragment is poorly preserved and since it shows more resemblance to the other examples of *S. campylotoxa* here discussed than to any of the other forms of *Sarasinella*, it may provisionally be included here.

[1] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, Pl. VI, figs. 3*c*, 4*c*, 6*b* (1902).

A doubtful fourth example, labelled "*Solgeria* sp." and still septate, is larger and more coarsely ribbed than those described above and the ribs are also more rectiradiate. The fragment could represent a form like Uhlig's fig. 3 at a larger diameter, but as little more than the peripheral aspect is well enough preserved for comparison, definite identification is impossible.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Chichali Pass (4).

Genus: NEOHOPLOCERAS, nov.

Genotype.—*N. submartini* (Mallada), p. 105, Pl. XVI, figs. 1*a-d.*

Diagnosis.—Rather inflated Neocomitids, with deep constrictions and rib-bundles, starting from umbilical tubercles and bearing lateral tubercles higher up, also single ribs without tubercles between, and specialised ribs, preceding the constrictions, and tuberculate each side of the smooth or grooved siphonal line. The lateral tubercle may disappear on outer whorl. Suture-line fairly simple (Pl. XVI, fig. 1*d*), with asymmetrical first lateral lobe.

Remarks.—Sayn referred *Amm. submartini* to the sub-genus *Hoplitides* (of the genus *Leopoldia*) but it has already been mentioned (p. 75) that since *Hoplitides* is a synonym of *Leopoldia*, the genus cannot be emended in Sayn's sense. Although *Neohoploceras* is connected by forms like *H. provincialis*, Sayn[1] with the genus *Sarasinella* and by *H. constrictus*, Uhlig,[2] with *Kilianella*, it is clearly a distinct group that requires a new name. The two additional species described below, with return to a *Thurmannites* ornamentation on the outer whorl, indicate that *Neohoploceras* had an independent origin and is not a derivative of *e.g.*, *Kilianella* or *Sarasinella*, but a parallel development, specialising in its own direction.[3]

77. NEOHOPLOCERAS SUBMARTINI (Mallada).

(Plate XVI, figs. 1*a-d.*)

1882. *Ammonites sub-Martini*, Mallada. *Bol. Com. Mapa geol. Espana*, Vol. IX, Pl. X, figs. 7-9; Pl. XI, figs. 12-14.

1887. *Ammonites sub-Martini*, Mallada: Sinopsis de las especies que se han encontrado en Espana, Pt. IV. *Bol. Com. Mapa geol. Espana*, Vol. XIV, p. 17.

1900. *Hoplites submartini* (Mallada) Paquier, *loc. cit.* (*Trav. Lab. géol. Grenoble*, Vol. V, fasc. 2), p. 253.

1901. *Holcodiscus sub-Martini* (Mallada) Simionescu, *loc. cit.* (*Trav. Lab. géol. Grenoble*, Vol. V), fasc. 2, p. 646.

1907. *Leopoldia* (*Hoplitides*) *submartini* (Mallada) Sayn, *loc. cit.* (*Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2), p. 57, Pl. IV, figs. 13 & 17.

1910. *Hoplitides submartini* (Mallada) Kilian, *loc. cit.* (Lethaea geognostica, fasc. 2), p. 219.

1924. *Hoplitides* aff. *submartini* (Sayn) Spath, *loc. cit.* (*Geol. Mag.* Vol. LXI), p. 75.

[1] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 58, Pl. VIII(IV), fig. 10 (1907).

[2] *Op. cit.* (Fauna of the Spiti Shales, fasc. 2), p. 230, Pl. LXXXII, fig. 5 (1910).

[3] The genus *Arnoldia*, Stolley (Die Gliederung des norddeutschen marinen Unterneocoms. *Zentralblatt f. Min. etc.* B, p. 453, 1937) has no standing, since the name has been used before; since it was meant for *Amm. arnoldi*, Pictot, it falls within the genus *Neohoploceras* (Note inserted in proof, December 1937).

This very distinctive species is represented by an example which is still septate at 53 mm. and is thus the largest individual known. The ornamentation is still that characteristic of the small syntypes of Mallada and the two larger and slightly differing specimens figured by Sayn, but in such a grotesquely ornamented species no two individuals are identical. The suture-line is well displayed and since Sayn called it nearly identical with that of his *Leopoldia* (*Hoplitides*) *depereti* I am figuring it to show that there really are considerable differences, although Sayn's drawing of the suture-line of *Sarasinella depereti* (text-fig. 26 on p. 59), enlarged five times, cannot be accepted as representative. The inner whorls, omitted in the figure, are not strikingly different from those of the form described below as *N.* sp. nov., so that it is possible that at larger diameters even *N. submartini* reverted to a more neocomitid aspect.

Horizon.—Valanginian (Belemnite Beds).

Locality.—687 (1).

78. Neohoploceras baumbergeri (Folgner MS.) sp. nov.

(Plate XXII, figs. 3*a*, *b*.)

Diagnosis.—Subplatygyral, subpachygyral, sublatumbilicate. Whorl-section depressed, hexagonal or octagonal, with steep and high umbilical wall but rounded edge. Venter broad, with distinct median groove. Ribs single and bifurcating, generally with a lateral tubercle, and principal bifurcating ribs also with an umbilical tubercle, less prominent than the lateral. Outer ribs untuberculate (except some, in the earlier stages), strongly projected and meeting at peripheral groove with an obtuse angle (130-140°). Strong constrictions in young. Suture-line comparatively simple, with low saddles, but incompletely known.

Measurements.

Diameter	53	42 mm.
Height of last whorl	38	41%
Thickness of last whorl	43	42%
Umbilicus	36	37%

Remarks.—Folgner had first described this species as *K.* nov. sp. aff. *superba* (Sayn) and stated that it showed close affinity with the French form. The unfinished account, however, does not go into the differences that made Folgner consider the present form as new. The inner whorls of *K. superba* (Sayn)[1] are those of a typical *Kilianella* (*lucensis* group), evolute and fairly coarsely ribbed. In the present form the earliest volutions are a miniature replica of *N. submartini* (Mallada) or of the other immature forms of *Neohoploceras* here figured (Pl. XV, fig. 10*c*; Pl. XVI, fig. 1*c*; Pl. XVII, fig. 8*c*); but while the ribbing is very fine, the lateral tubercle is at first small and the inner tubercle does not appear until about 15 mm. diameter. At the size of Sayn's paratype (fig. 19) the two forms are indeed very much alike, but the specific separation is supported by the difference in the ventral aspect. The holotype of *K. superba* at a comparable diameter (bottom of Sayn's fig. 18*b*) shows strong peripheral terminations of the ribs, placed

[1] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, p. 51, Pl. IV, figs. 18-20 (1907).

almost radially. In the present form they are not only placed very obliquely, but the thickening of the ribs is very slight on the outer whorl. The whorl-section is also more depressed in the Salt Range species.

There is, however, a fragment of a more compressed form which is difficult to compare with the holotype of the present species on account of its larger size (whorl-height=34 mm., thickness=30 mm.). It may represent the outer whorl of a form like that described above as *Kilianella* ? (" *Acanthodiscus* ") sp. nov. cf. *lamberti* (Sayn), but it has sharper ribs than *K. superba* and at the end still shows a pair of those remarkable ventral bosses that characterise *N. submartini*. The ribs preceding this tuberculate pair have lateral and apparently also inner tubercles and there are some single ribs without any tubercles. Folgner labelled this fragment " *Hoplites* (*Acanthodiscus*) ? *syncostatus*, Baumberger ", but did not describe it. The comparison is not inapt, for this species and its allies described by Baumberger[1], especially *N. arnoldi* (Pictet and Campiche)[2] are undoubtedly close to the form here described. In view of the very imperfect state of preservation of this fragment, however, definite identification with any of the Swiss or French species is impossible.

Horizon.—Neocomian (Belemnite Beds).

Locality.—Chichali Pass (2).

79. Neohoploceras, sp. nov.

(Plate XVII, figs. 8*a-c*.)

Like the fragment described below as *N.* ? sp. ind. the present form was difficult to place until the inner whorls could be exposed. These, however, at a diameter of about 30 mm. are almost indistinguishable from *N. submartini*. The only difference I can see (in the third of the penultimate whorl that remained in the dorsal area of the fragment) is that the umbilical tubercles tend to be less conspicuous or, when strongly developed, they are not on the same rib as the very prominent lateral tubercle. The strong rib, preceding a deep constriction, also is tuberculate at the side, not only on the venter, as in *N. submartini*. What little is preserved of the innermost whorls could not be distinguished from a corresponding portion of Mallada's species. It should be added that there is a slight malformation on one side of the penultimate whorl, but the fragment of the outer volution is again perfectly symmetrical. This is also septate and the suture-line agrees with that of *N. submartini*.

The whorl-section of the large fragment is similar to that of *Neocomites* sp. nov. aff. *platycostatus*, Sayn, but the greatest thickness is at the tuberculate umbilical rim, so that the flattened sides are strongly convergent. The ribbing is irregular and somewhat resembles that of *Neocomites paraplesius* (Uhlig)[3] though it is more flexuous, more reclined, and provided with strong umbilical tubercles, above a high and vertical umbilical wall. There are also two constrictions, preceded by strong ribs which, gradually broadening towards the periphery,

[1] *Abh. Schweiz. Pal. Ges.*, Vol. XXXII, pp. 63, etc. (1906).
[2] *Mat. Pal. Suisse*, II, 2, p. 252, Pl. XXXV, figs. 1-3 only (1860).
[3] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXII, p. 59, Pl. II, figs. 8*a-c* (1902).

there develop large and flat tubercles. Viewed from above, these tubercles, separated by the smooth siphonal band, are almost perfect squares, but the seven pairs of untuberculate ribs which (on the periphery) lie between the two pairs of square nodes run up to the smooth median zone without any thickening and are not projected forwards on the venter.

Apart from the fact that the lateral tubercle has disappeared and that the section has become compressed instead of depressed, the ornamentation is still that of *Neohoploceras*, yet the presence of some strong ribs recalls the costation of forms like *Neocomites platycostatus*, Sayn[1]. Much more closely related, however, is *Kilianella constricta* (Uhlig)[2], a cast of which is before me (B. M. No. C. 14091). With its wider whorl-section it might, indeed, be thought to represent a stage intermediate between the outer and inner whorls of the present form, but the peripheral aspect is different; for the ribs are not straight but projected on the venter. The Himalayan form also has a larger umbilicus and a lower whorl-side, as well as a wider periphery, and the shorter ribs are more regularly bifurcating.

Horizon.—Neocomian, Belemnite Beds.

Localities.—687 (1); 50 (1).

80. Neohoploceras (?) sp. ind.

(Plate XV, figs. 10*a-d*; Plate XXI, figs. 8*a*, *b*.)

A septate whorl-fragment was at first taken to belong to a form of *Neocomites* or *Thurmannites*, but on developing the dorsal area, the penultimate whorl could be exposed and this, unexpectedly, turned out to be depressed and tri-tuberculate, constricted, and altogether much like the inner whorls of *N. submartini*. The lateral tubercles, however, are smaller, the umbilical bullae sharper and less conspicuous, and the ventral tubercles, at the constrictions, less exaggerated. Moreover, there are neat and sharp spines on all the intermediate ribs, where they pass over the ventro-lateral edges; and the short continuations of the ribs, on the comparatively wide venter, slope down to a distinct median groove, so that the cross-section is very characteristic.

The outer whorl has a section similar to that of the form above described as *Neocomites* (*Thurmannites* ?) sp. ind., with the greatest thickness at the tuberculate umbilical rim and convergent sides. The umbilical wall is high and almost perpendicular. The ribs, bidichotomous or single, or a combination of these, are flexuous and end in small tubercles, at the ventro-lateral edges, those preceding the constrictions in larger tubercles which, however, are not nearly so conspicuous as those of the new form last described. The suture-line with an asymmetrical first lateral lobe is similar to that of *N. submartini*.

The present form is somewhat comparable to the tuberculated variety of *Thurmannites thurmanni* figured by Kilian[3] and associated by v. Koenen with his *Hoplitides heteroptychus* (Pavlow ?). For, as these forms are transitional to *Sarasinella*, so the present form leads to the typical *Neohoploceras submartini*.

[1] *Mém. pal., Soc. géol. France*, Vol. XV, fasc. 2, Pl. VII(III), fig. 1 (1907).

[2] *Op. cit.* (Fauna of the Spiti Shales, fasc. 2), p. 230, Pl. LXXXII, fig. 5 (1910).

[3] *Bull. Soc. Statist.*, Isère, Pl. IV, figs. 2-3 (1892).

It is impossible, however, to distinguish these forms in fragments of outer whorls; and the present fragment and the form here described as *Neocomites* (*Thurmannites* ?) sp. ind. (p. 89), with identical ribbing in the adult, were at first believed to belong to the same species.

A small fragment of inner whorls, still trituberculate, and figured in Pl. XXI, figs. 8*a*, *b*, was received with the Wynne collection and like a more doubtful and larger example was labelled "*Hoplites* (*Solgeria*) cf. *karakaschi*, Uhlig=aff. *desori*, Karakasch". There is undoubted resemblance to the smaller examples figured by Karakasch[1], but since the holotype (figs. 1, 2) is still bituberculate at a comparatively large diameter it is doubtful whether they represent the same species or whether they have anything to do with *Neohoploceras*. The drawings, moreover, are rather bad, and in Karakasch's later work of 1907 I can see nothing reminiscent of *Sarasinella* or *Neohoploceras*, except a large example of *Hoplites karakaschi*[2] which has nothing in common with the smaller examples above referred to.

Horizon.—Neocomian, Belemnite Beds.

Localities.—687 (1); 692 ? (1); Makerwal Colliery (? 1); Chichali Pass (2 ?).

Genus: Distoloceras, Hyatt, 1900.

81. Distoloceras ? sp. ind.

(Plate XVI, fig. 6.)

This form is very doubtful because the only fragment in the collection has suffered from corrosion; and it is difficult to say how much of the peculiar peripheral aspect is due to the weathering. But the very loose coiling alone separates this form from all the other ammonites here described, except some species of *Subthurmannia* or *Parandiceras*; and in these the ribbing is different. The fragment is crushed, but the whorl-section was probably compressed since the venter is narrowly arched; the sides are flattened and the umbilical wall is high and perpendicular, and the edge rounded. The ribs are flexuous, projected on the venter, but continuous across; and they seem to be all single, but of unequal strength. There is no sign of ventral tubercles as in the group of *D. longinodus* (Neumayr and Uhlig)[3] and *D. curvinodus* (Phillips)[4], which forms are connected with the genotype of *Distoloceras* (*D. hystrix*, Phillips sp.)[5] by many transitions.

The dorsal area is scarcely indented, so that the involution must have been very slight. Unfortunately it could not be cleared of matrix to show the ornamentation of the venter of the penultimate whorl. The section thus also supports the reference to *Distoloceras*, but the identification must remain very tentative. I can see no resemblance to the true *Favrella americana* (Favre).

Horizon.—Neocomian, Belemnite Beds.

Locality.—682 (1).

[1] *Sitz. B. k. Akad. Wiss. Wien.* Vol. XCVIII, Pl. II, figs. 4*a*, *b*; 6 (1889).

[2] *Trav. Soc. Imp. Nat. St. Pétersb.*, Vol. XXXII, Pl. X, fig. 22 (1907).

[3] *Palaeontogr.* Vol. XXVII, p. 172, Pl. XXXVII, figs. 2-3 (1881).

[4] See *ibid.*, Pl. XLIII, fig. 3.

[5] See *ibid.*, Pl. XLII, fig. 3; and Pavlow, *op. cit.* (Argiles de Speeton), p. 463, Pl. XVII, fig. 10 (*Hoplites*) (1892).

B. BELEMNOIDEA.

Family : *BELEMNITIDAE.*

Sub-family : *BELEMNOPSINAE*, Naef, 1922.

Genus : BELEMNOPSIS, Bayle, 1878.

82. BELEMNOPSIS GERARDI (Oppel) Uhlig sp.

(Plate XXIV, figs. 11-13.)

1910. *Belemnites* (*Belemnopsis*) *gerardi*, Oppel ; Uhlig, *op. cit.* (**Fauna of the Spiti Shales, fasc. 3), p. 386, Pls. XCIII and XCIII-A.**

1914. *Belemnites gerardi* (Oppel) ; Spitz, *loc. cit.* (*Rec. Geol. Surv. India*, Vol. XLIV, Pt. 3), p. 223.

1933. *Belemnopsis gerardi* (Oppel) Uhlig ; Spath, *loc. cit.* (*Pal. Indica*, New Series, Vol. IX, Mem. No. 2, Pt. VI), p. 661.

There are only a few fragmentary guards of a form or forms of *Belemnopsis* among hundreds of *Hibolites* and they are provisionally referred to *B. gerardi*, a " controversial " species which I have only recently discussed ; but the new material does not enable me to add to that discussion. It may suffice to recapitulate that there is no evidence for an Upper Oxfordian age of Oppel's Kalabagh examples ; that no ammonites higher than the *anceps* zone are known from the neighbourhood ; and that a greenish-grey, glauconitic limestone matrix characterises such examples from the Neocomian Belemnite beds and their Tithonian base as that figured in Pl. IV, fig. 6. Moreover, the *Amm. macrocephalus* and numerous fragments of *planulati* mentioned by Oppel (and apparently lost) may well refer to *Olcostephanus* and such Spiti Shales Perisphinctids as those figured in Pl. XV, fig. 8 and Pl. XVI, fig. 8, which occur north of Kalabagh. The name thus may well be used for the uppermost Jurassic and Lower Neocomian species of the higher stages of the Spiti Shales rather than for the Oxfordian form which is so abundant in the Himalayan Belemnite beds at the base of the Spiti Shales, supposing the two are really different.

The examples figured in Pl. XXIV, figs. 11-12, show the characteristic ventral groove which, as in Uhlig's figs. 10*a*, 12*a* and 13*a*, does not reach to the apex. The specimen figured in Pl. XXIV, fig. 14, has a shorter groove than any of Uhlig's examples or the Madagascan specimen of *B. africana* (Tate), represented in Pl. XXIV, fig. 15, and may therefore belong to a distinct form. Its cross-section is even more depressed than that of Uhlig's fig. 12*b* which Stolley[1] already thought could scarcely belong to " *B. gerardi* ". In still another example (Pl. XXIV, fig. 13), an apical fragment which, in a length of 54 mm., has increased to a diameter of 19·5 mm. in the ventro-dorsal and of 20·5 mm. in the lateral direction, the groove seems to be continuous to the point, which, however, is worn. The cross-section is similar to Uhlig's fig. 12*b*, but slightly less depressed ; the general shape is that of Uhlig's fig. 9*a*, except that the present fragment belonged to a much larger guard.

[1] Über ostindische Jura-Belemniten. *Pal. v. Timor*, Lief. xvi, No. 29, p. 152 (1929).

Two of the examples were accompanied by seven fragments of Spiti Shales (Chidamu Stage) *Aulacosphinctoides* and the *Hildoglochiceras* figured in Pl. XVIII, figs. 8*a*, *b*, and like these may be held to have been derived from Upper Jurassic beds below the Belemnite shales. Since even the pyritised (now limonitic) examples of *Himalayites*, *Neocosmoceras*, *Blanfordiceras*, etc., of the same assemblage could be considered to be of Tithonian age, it is possible that the two belemnites are indeed Jurassic. But the same assemblage also includes cylindrical and slightly depressed forms of *Hibolites* like those from the Neocomian Belemnite shales. Another example again was the only *Belemnopsis* among 80 belemnites (*Hibolites*) and came from grey and green shales below a pisolitic haematite bed; and since a dark green sandstone immediately below the haematite zone at a neighbouring locality (K. 35/814=1½ miles N.N.W. of Kalabagh) has yielded *Subthurmannia*, *Neocomites* and *Parandiceras theodorii* (Oppel), it is probable that this assemblage is truly Cretaceous. Finally the examples figured in Pl. XXIV, figs. 12 and 14, were in an assemblage (with *Hibolites subfusiformis*) that came from Belemnite shales underlying the Nummulitics (*i.e.*, the "basal Laterite bed") and therefore scarcely of Jurassic age.

It may be added that some phragmocones similar to the example figured in Pl. XXIII, fig. 11, and collected by Wynne were referred by Folgner to the present species. They resemble those figured by Uhlig from the Spiti Shales, though they are less compressed; but they are here attached to *Hibolites subfusiformis* (Raspail) simply because it is the dominant belemnite in these shales and *B. gerardi* seems to be exceedingly rare.

Horizon.—Upper Jurassic (and Lower Neocomian ?). Belemnite shales and beds below.

Localities.—680=768 (2); K. 35/812, 1⅓ miles N. of Kalabagh (1); K. 35/776, about 3½ miles S. W. of Nawan, Salt Range (2).

Genus: Hibolites (Montfort) Mayer-Eymar, 1883.

83. Hibolites subfusiformis (Raspail).

(Plate XXIII, figs. 1-14; Plate XXIV, figs. 4-10.)

1897. *Belemnites subfusiformis*, Raspail; Noetling: Fauna of Baluchistan, Vol. I, Pt. 2. Fauna of the (Neocomian) Belemnite Beds. *Pal. Indica*, Ser. XVI, p. 4, Pl. I, figs. 4-14.

1903. *Belemnites subfusiformis*, Raspail; Koken: Kreide und Jura in der Salt-Range. *Centralblatt*, p. 442.

1910. *Belemnites* (*Hibolites*) *jaculum*, Phillips; Kilian. *loc. cit.* (Lethaea geogn., fasc. 2), pp. 199, 201, etc.

1910. *Belemnites subfusiformis*, Raspail; Uhlig: Die Fauna der Spitischiefer des Himalaya, ihr geologisches Alter und ihre Weltstellung. *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXXV, p. 57.

1914. *Belemnites* cf. *subfusiformis*, Raspail; Zwierzycki, *loc. cit.* (*Archiv. f. Biontol.*, Vol. III, No. 4), III, p. 20, Pl. I, fig. 3.

1920. *Hibolites subfusiformis* (Raspail) Bülow-Trummer: Fossilium Catalogus (Diener) I, *pars* 11, p. 154 (with synonymy).

1922. *Hibolites subfusiformis* (Raspail) Naef: Die fossilen Tintenfische. Jena, p. 249.
1929. *Belemnites (Belemnopsis) subfusiformis*, Raspail; Barrabé, *loc. cit.* (*Mém. pal., Soc. géol. France*, N. S., Vol. V, fasc. 3-4), pp. 151-153.
1929. *Hibolites subfusiformis* (Raspail) Stolley: Über Ostindische Jura-Belemniten. *Pal. v. Timor*, Lief. 16, Abh. 29, p. 131.
1930. *Belemnites subfusiformis*, Raspail; Besairie, *loc. cit.* (*Bull. Soc. hist. nat., Toulouse*, Vol. LX, fasc. 2), Pl. XIV, figs. 2, 2*a*; Pl. XV, figs. 2-5.
1932. *Hibolites subfusiformis* (Raspail) Ackermann, *loc. cit.* (*Abh. Sächs. Akad. Wiss. Leipzig*, Vol. XLI, Heft V), p. 25.
1933. *Belemnites subfusiformis*, Raspail; Tzankov: Sur le Valanginien dans la Bulgarie de N. E. *Revue Soc. géol. bulg.*, Vol. V, p. 90.
1935. *Hibolites subfusiformis* (Raspail) Stolley: Über ungewöhnliche Cephalopoden der norddeutschen Unterkreide, etc. *N. Jahrb. f. Min., etc., Beil. Bd.* 73, Abh. B, p. 392.
1936. *Aulacobelus subfusiformis* (Raspail) d'Orbigny sp.; Breistroffer, *loc. cit.* (*Bull. Soc. Sci. Dauphiné*, sér. 5, Vol. XIV), p. 534.

As in the Belemnite Beds of Baluchistan, so in the Salt Range this species occurs in enormous numbers but always in a fragmentary condition. The best and most complete examples here figured are scarcely as well preserved as those depicted by Noetling; and there is not a specimen showing the whole of the ventral groove and a complete alveolus. Conversely, there are many isolated portions of phragmocones, some of large size (see Plate XXIII, figs. 11*a-c*); and since the present species is almost the only and certainly the most abundant belemnite in the beds, these phragmocones are not likely to have belonged to another species. Folgner, however, doubtfully referred eight such phragmocones in the Wynne collection to *Belemnopsis gerardi*.

Many of the guards are weathered, and a great variety of shapes results, far greater than shown in Noetling's examples (including the var. *baluchistanensis*). Some are even crushed or weathered to such an extent as to resemble a flat *Duvalia*; others are bent (Pl. XXIII, fig. 6), or deformed (Pl. XXIII, fig. 9), or exfoliating (Pl. XXIV, fig. 4), but the great majority of the specimens before me are pieces too short to be identified. They are not so well preserved as some Madagascan examples (see Pl. XXIII, fig. 1) kindly sent to me by Dr. Besairie, which came from a bed with belemnites (including *Duvalia*) above the rock that yielded *Subthurmannia* and *Kilianella*, etc., but below the *Rogersites* beds in which the dominant belemnite, *Belemnopsis africana* (Tate)[1] (Pl. XXIV, fig. 15) is accompanied by the form figured in Pl. XXIV, fig. 10.

This variety with longer ventral groove is probably the same as that figured in Noetling's fig. 12 and, like the examples represented in Pl. XXIV, figs. 5-9, it is depressed for a much shorter length of its guard, measured from the apex, than the typical and apparently earlier form which is depressed almost to the alveolar end. With the large var. *baluchistanensis*, Noetling, there may thus be in reality three distinct species, not counting those transitions to *H. pistilliformis* which include the originals of Pl. XXIII, figs. 13-14. In view of the defi-

[1] See Besairie: Fossiles charactéristiques du N. et du N. E. de Madagascar. *Ann. géol., Service des Mines*, fasc. 2, p. 43 (1932).

ciency of good material, however, and the lack of exact stratigraphical information it is considered advisable to interpret the species in a very wide sense.

The present form, like *H. pistilliformis*, according to Kilian[1] appears in the Upper Valanginian, but passes up into the Barremian. I do not consider *H. subfusiformis*, or at least the Salt Range belemnites here discussed, identical with the Speeton *H. jaculum* (Phillips), so abundant in the Hauterivian C beds; but since many of the fragments before me could not be distinguished from the (typically more depressed) Jurassic *H. flemingi*, Spath,[2] it is possible that there is such an uninterrupted succession of similar *Hibolites* from the Upper Jurassic into at least the Hauterivian, that they are practically useless for zoning.

Horizon.—Neocomian, Belemnite Beds. Some examples from the Chichali Pass were labelled by Wynne " lowest fossil layer in the Greensands ".

Localities.—Most of the localities listed on pp. 115-125 (about 500 specimens, apart from those in the matrix of some of the ammonites).

84. Hibolites (Hastites ?) pistilliformis (Blainville).

(Plate XXIV, figs. 1-2.)

1897. *Belemnites pistilliformis*, Blainville; Noetling, *loc. cit.* (*Pal. Indica*, ser. XVI, Vol. I, Pt. 2), p. 3, Pl. II, figs. 8-11.

1910. *Belemnites* (*Hibolites*) *pistillirostris*, Pavlow; Kilian, *loc. cit.* (Lethaea geognostica), p. 199.

1914. *Belemnites pistilliformis*, Blainville; Zwierzycki, *loc. cit.* (*Archiv. f. Biontol.*, Vol. III, No. 4), Pt. III, p. 19, Pl. I, figs. 6-7.

1920. *Hibolites pistilliformis* (Blainville) Bülow-Trummer, *loc. cit.* (Fossilium Catalogus), p. 148 (with synonymy).

1922. *Hastites pistilliformis* (Blainville) Naef: Die fossilen Tintenfische, p. 227.

1927. *Hibolites* (*Hastites* ?) *pistilliformis* (Blainville) Spath, *loc. cit.* (*Pal. Indica*, N. S., Vol. IX, No. 2, Pt. 1), p. 17.

1929. *Belemnites* (*Belemnopsis*) *pistilliformis*, Blainville; Barrabé, *loc. cit.* (*Mém. pal., Soc. géol. France*, N. S., Vol. V, fasc. 3-4), pp. 151-153, Pl. XXII, figs. 10-11.

1930. *Belemnites pistilliformis*, Blainville; Besairie, *loc. cit.* (*Bull. Soc. hist. nat., Toulouse*, Vol. IX, fasc. 2), Pl. XIV, figs. 1, 1*a*.

1932. *Hibolites pistilliformis* (Raspail) Ackermann, *loc. cit.* (*Abh. Sächs. Akad. Wiss. Leipzig*, Vol. XLI, Heft V), p. 24.

1932. *Belemnites* cfr. *pistilliformis*, Barbu; Catalogul Cephalopodelor Fosile din Romania. *Acad. Rom. Mem. Sect. Stiint.*, ser. iii, Vol. 8, mem. 8, p. 34.

1933. *Belemnites* cfr. *pistilliformis*, Blainville; Tzankov, *loc. cit.* (*Revue Soc. geol. bulg.*, Vol. V), p. 90.

1933. *Belemnites* cfr. *pistilliformis*, Blainville; Cohen, *loc. cit.* (*Zeitschr. Bulgar. Geol. Ges.*, Vol. V), p. 165 (? Pl. II, figs. 16*a,b*).

1936. *Aulacobelus pistilliformis* (Blainville) Raspail sp.; Breistroffer: *loc. cit.* (*Bull. Soc. Sci. Dauphiné*, ser. 5, Vol. XIV), p. 535.

There are only a few examples of this species, two of them here figured, but of these the larger is corroded at the upper end and the smaller near the apex,

[1] Lethaea geognostica, fasc. 2, p. 199 (1910).

[2] *Pal. Indica*, N. S., Vol. IX, Mem. 2, Pt. 1, p. 13, Pl. I, fig. 2 (1927).

so that a possibility remains that their pistilliform shape is accidental. It seems, in fact, that there are all transitions between the two examples and the extremely abundant *H. subfusiformis* (*e.g.*, Pl. XXIII, figs. 13-14); and instead of separating them in different genera, as Naef did, one might be tempted to follow those authors, from Pictet to Keeping[1], who united them as varieties in the same species. The poor state of preservation of the Salt Range belemnites, however, does not warrant a pronouncement on the validity or otherwise of the species and I use the names in the sense of Barrabé and Besairie, the Madagascan examples being fairly well preserved, and often complete.

Horizon.—Neocomian, Belemnite Beds.

Localities.—674 (1); 683 (1).

[1] Fossils Upware and Brickhill, p. 85, Pl. I, figs. 6a-c (1883).

III. THE LOCALITIES AND THEIR FAUNAL ASSEMBLAGES.

It is advisable to list the cephalopods above described according to their localities, because the fossils indicate different dates and the age of many may only be inferred from the nature of the assemblages in which they were found. Since all the ammonites are from the Belemnite Shales, the commonest belemnite (*Hibolites subfusiformis*, Raspail sp.) may be added to all the assemblages, although there are no actual specimens before me from some places. The localities are partly in the western portion of the Salt Range proper (see text-fig. 1, p. 125) and partly in the Trans-Indus continuation, notably the neighbourhood of the Chichali Pass and hills, west of Kalabagh. Taking the latter section first, the most representative assemblage comes from—

(a) Tributary just east of Kotki, Chopri, Chichali (No. 687), including the following species, in addition to a number of unidentifiable fragments :—

2. *Neolissoceras grasianum* (d'Orbigny).
3. *Olcostephanus salinarius*, sp. nov.
4. „ sp. ind. cf. *drumensis* (Sayn MS.), Kilian.
5. „ *globosus*, sp. nov.
6. „ *glaucus*, sp. nov.
13. „ *geei*, sp. nov.
17. „ (*Rogersites*) *schenki* (Oppel).
25. *Blanfordiceras* aff. *wallichi* (Gray).
27. „ cf. *acuticosta* (Uhlig).
31. *Subthurmannia media*, sp. nov.
32. „ *patella*, sp. nov.
33. „ *lissonioides*, sp. nov.
34. „ *fermori*, sp. nov.
35. „ sp. ind.
36. „ sp. ind. cf. *lorensis* (Lisson).
37. „ (*Berriasella* ?) sp. ind.
38. „ *transitoria*, sp. nov.
39. „ sp. nov. aff. *transitoria*, nov.
40. „ sp. nov. ?
41. „ *filosa*, sp. nov.
42. „ (Gen. nov. ?) *pseudopunctata*, sp. nov.
43. *Raimondiceras* (?) *salinarium*, sp. nov.
44. *Himalayites* cf. *seideli* (Oppel).
47. *Protacanthodiscus* (?) sp. ind.
51. *Neocosmoceras* (" *Acanthodiscus* ") sp. ind.
56. *Thurmannites* cf. *pertransiens* (Sayn).
58. „ (?) sp. ind.
59. *Neocomites similis*, sp. nov.
60. „ sp. nov. aff. *platycostatus*, Sayn.
61. „ sp. nov. cf. *teschenensis* (Uhlig).
62. „ sp. nov. ind. cf. *noriciformis* (Hohenegger MS.), Uhlig sp.
69. *Kilianella asiatica*, sp. nov.
71. „ *besairiei*, sp. nov.
72. „ ? (" *Acanthodiscus* ") sp. nov. cf. *lamberti* (Sayn).

75. *Sarasinella* (?) sp. ind. nov. ?
77. *Neohoploceras submartini* (Mallada).
79. ,, sp. nov.
80. ,, (?) sp. ind.

This list includes many species which have not been found elsewhere but, apparently, they are all Valanginian and Infra-Valanginian types, except, perhaps, the forms of *Blanfordiceras*, *Himalayites*, and *Protacanthodiscus* (?). *Himalayites* was considered by Uhlig to be chiefly Tithonian, but *H. egregius* (Steuer) is said to occur well up in the Valanginian succession of the Argentine Andes, and it is so close to *H. seideli* (Oppel) of the Spiti Shales that there seems to be no reason to assume the Indian *Himalayites* to be entirely Jurassic. Three examples of a small *Exogyra* and one (derived) fragment of a form of *Aulacosphinctoides* of the Chidamu stage of the Spiti Shales were also included in the collection from this locality.

A smaller assemblage is from—

(b) Right side of Chichali Pass, up stream from Kotki, Chopri (Nos. 685 and 687A).

3. *Olcostephanus salinarius*, sp. nov.
5. ,, cf. *globosus*, sp. nov.
6. ,, *glaucus*, sp. nov.
7. ,, *fascigerus*, sp. nov.
9. ,, *sublaevis*, sp. nov.
11. ,, sp. ind.
12. ,, cf. *perinflatus* (Matheron).
14. ,, *radiatus*, sp. nov.
17. ,, (*Rogersites*) *schenki* (Oppel).
25. *Blanfordiceras* aff. *wallichi* (Gray).
25*a*. ,, ? sp. (transitional to *Thurmannites*).
28. ,, cf. *boehmi* (Uhlig).
32. *Subthurmannia patella*, sp. nov.
33. ,, *lissonioides*, sp. nov.
35. ,, sp. ind.
36. ,, sp. ind. cf. *lorensis* (Lisson).
38. ,, cf. *transitoria*, sp. nov.
39. ,, sp. nov. aff. *transitoria*, sp. nov.
40. ,, sp. nov. ?
41. ,, *filosa*, sp. nov.
60. *Neocomites* sp. nov. aff. *platycostatus*, Sayn.
65. ,, (*Thurmannites* ?) sp. ind.
71. *Kilianella besairiei*, sp. nov.

The four species peculiar to this assemblage (three forms of *Olcostephanus* and one doubtful *Neocomites*) are not of any significance; but it is interesting to note that, as in the first assemblage, *Blanfordiceras* is again represented. Instead of the vertical distribution of that genus "coinciding with the passage beds between the Jurassic and Cretaceous systems" as Uhlig thought, it may extend into the Infra-Valanginian; for the suturally reduced *Pseudoblanfordia australis* (Burckhardt) is now known to occur in the uppermost Valanginian zone of *Steueroceras*

transgrediens (Steuer). In addition to some unidentifiable fragments, including pieces of probably very large specimens of *Olcostephanus* (*Rogersites*) *schenki* (Oppel), some reptilian bones, and an example of a "*Vermicularia*," there is again a derived fragment of an *Aulacosphinctoides* of the Lower Spiti Shales, comparable to the form figured in Pl. XV, figs. 8*a-b* (*A.* aff. *uhligi*, Spath).

(c) **Chichali Pass (Wynne collection).** This locality may include some of the others here discussed, for example the last locality, and it does not represent a single section. Yet the fauna is very uniform, for the long list includes only about three forms whose Neocomian age might be questioned by some.

3. *Olcostephanus salinarius*, sp. nov.
6. ,, *glaucus*, sp. nov.
7. ,, *fascigerus*, sp. nov.
8. ,, *victoris* (Folgner MS.), sp. nov.
9. ,, *sublaevis*, sp. nov.
10. ,, *pachycyclus* (Folgner MS.), sp. nov.
15. ,, cf. *madagascariensis*, Lemoine.
16. ,, *wynnei* (Folgner MS.), sp. nov.
17. ,, (*Rogersites*) *schenki* (Oppel).
18. ,, (*Rogersites*) cf. *atherstoni* (Sharpe).
25. *Blanfordiceras* aff. *wallichi* (Gray).
30. ,, (Gen. nov. ?) sp. nov.
31. *Subthurmannia media*, sp. nov.
33. ,, *lissonioides*, sp. nov.
34. ,, *fermori*, sp. nov.
35. ,, sp. ind.
36. ,, sp. ind. cf. *lorensis* (Lisson).
38. ,, *transitoria*, sp. nov.
39. ,, sp. nov. aff. *transitoria*, sp. nov.
40. ,, sp. nov. ?
41. ,, *filosa*, sp. nov.
50. *Neocosmoceras hoplophorum* (Folgner MS.), sp. nov.
57. *Thurmannites* (*Kilianella* ?) sp. nov.
63. *Neocomites* aff. *neocomiensiformis* (Hohenegger MS.), Uhlig.
65. ,, (*Thurmannites* ?) sp. ind.
70. *Kilianella* cf. *pexiptycha*, Uhlig.
72. ,, ? ("*Acanthodiscus*") sp. nov. cf. *lamberti*, Sayn.
73. *Sarasinella uhligi*, sp. nov.
74. ,, *chichalensis* (Folgner MS.), sp. nov.
75. ,, (?) sp. ind. nov. ?
76. ,, aff. *campylotoxa* (Uhlig).
78. *Neohoploceras baumbergeri* (Folgner MS.), sp. nov.
80. ,, (?) sp. ind.

Apart from a few small belemnite fragments, this collection also included a Jurassic *Virgatosphinctes*. This was labelled by Folgner *V.* aff. *brancoi*, Uhlig (probably a slip, and meant for *V. broilii*, Uhlig), and it is now figured in Pl. XXII, fig. 10. Still more interesting is the ammonite represented in Pl. XX, fig. 6, which was described by Folgner as *Schloenbachia* sp. He obviously took it to be

a Neocomian *Oosterella*, but his description significantly ended with the sentence: " Vergleichspunkte geben sich zu folgenden Formen " and then was left unfinished. The septate fragment seems to me to be a Callovian *Putealiceras* (group of *Harpoceras trilineatum*, Waagen) and must have come, directly or indirectly, out of the Jurassic limestone below the Belemnite Shales. The specimen was labelled by Wynne " below *Amm. astierianus* " and has written on it in ink *Amm. scriptus*; but, of course, there is no affinity or resemblance whatever to *Spiticeras scriptum* (Strachey MS.) Blanford sp. of the Spiti Shales.

Folgner, who studied the Wynne collection, thought that the beds that yielded the fossils were composed of an upper and a lower portion. The latter, the so-called " Ammonite Sandy Beds " (here *Subthurmannia* Beds) he correlated with the Infra-Valanginian in Kilian's sense, and to this complex he attributed " the smaller and less well-preserved portion " of the collection. The upper part of the Belemnite Beds was not discussed by Folgner in his fragmentary MS. notes, but on the labels the ammonites he presumed to have come from this upper portion, and the Neocomitids especially were marked " Lower Hauterivian ". This division, it must be emphasised, is not based on information supplied by the collector; for few of Wynne's labels (originally perhaps very comprehensive) are now with the specimens and they are not as helpful as the matrix and mode of preservation, although these too may yield conflicting evidence. On the whole, however, the ammonites of the presumed upper portion (or the *Neocomites* beds) can be recognised by being in a better state of preservation and by their frequent calcite infilling or the yellowish-brown colour, compared with the dark green of the fossils from the presumably lower set.

A few specimens of *Olcostephanus salinarius*, sp. nov., labelled " Chichali Hills " or " Kalabagh ", from old collections, and some examples of *Olcostephanus* and *Subthurmannia* from Chichali Nala in Mr. Morris's collection, as well as the following small trans-Indus assemblages are of less importance stratigraphically.

(d) Upper slopes about 1¾ miles north of Kuch, " mainly from near base of Belemnite horizon, where it rests on the Jurassic limestone ". (No. 699.)

3. *Olcostephanus salinarius*, sp. nov.
28. *Blanfordiceras* cf. *boehmi* (Uhlig).

These two forms were associated with a " *Vermicularia*," and six interesting perisphinctoid fragments, only one of which is obviously a derived Jurassic Spiti Shales form. The others, one of which is figured in Pl. IV, figs. 7*a*,*b*, like the Gen. nov. (" *Aulacosphinctes* " ?) sp. ind. nov. ? described under No. 24, I cannot satisfactorily place. They have a compressed or square, Berriasellid, whorl-shape, but no distinct siphonal groove, and they show more resemblance to certain Perisphinctids earlier than those of the Spiti Shales, than to any Cretaceous form here described, except the *Blanfordiceras* (*Berriasella* ?) sp. ind. figured in Pl. VI, figs. 2*a*,*b*. Judging by the more numerous derived Perisphinctids from locality 682, however, the specimens may owe their peculiar aspect, at least partly, to bad preservation and wear; and it would be risky, on the strength of the figured fragment alone, to determine the age of the formation that yielded these perisphinctoids.

It is probably intermediate between the Valanginian (represented by *Olcostephanus*) and the Jurassic Chidamu Stage of the Spiti Shales.

Three belemnites from a limestone at the same locality, presumably below the Belemnite Shales and therefore of Jurassic age, include the original of Pl. XXIV, fig. 3, which cannot be distinguished from *Hibolites pistilliformis* of the Neocomian. All the thirty belemnites of the second collection, however, from North of Kuch (K. 35/779) are *Hibolites subfusiformis* in the typical preservation and they include the original of Pl. XXIII, fig. 2.

(e) North of Kalabagh (No. 692).

3. *Olcostephanus salinarius*, sp. nov.
60. *Neocomites*, sp. nov. aff. *platycostatus*, Sayn.
71. *Kilianella besairiei*, sp. nov.
80. *Neohoploceras* (?) sp. ind.

They were associated again with two fragments (one in shiny, black phosphate ?) of Jurassic *Aulacosphinctoides*, derived from an earlier deposit. The belemnites in the second consignment (K. 35/812) from 1⅓ miles N. of Kalabagh (marked "grey and green shales below pisolitic haematite beds") included two examples of *Hibolites subfusiformis*, here figured, in addition to some 80 fragmentary guards of the three varieties of this species, discussed on p. 112, and only a single *Belemnopsis* aff. *gerardi*, with a short and shallow groove.

(f) 1½ miles N. N. W. of Kalabagh (loc. 814), from a dark, greenish-brown sandstone, just below the haematite zone. The five ammonites from this locality are referable to three species, namely :—

54. *Parandiceras* sp. nov. ind.
55. ,, *? theodorii* (Oppel).
60. *Neocomites* sp. nov. aff. *platycostatus* (Sayn).

The accompanying 33 belemnites from the same locality were marked "Shales below laterite bed", and included four examples of *Hibolites subfusiformis*, here figured; but the remainder also all belong to this one species and its varieties.

A considerable number of specimens come from the Makerwal[1] District and they are grouped in the following four assemblages :—

(g) Northern side of Miranwal Nala, Makerwal Colliery, from near the base of the Belemnite Shales (Nos. 682 and 791).

3. *Olcostephanus salinarius*, sp. nov.
9. ,, *sublaevis*, sp. nov.
22. *Spiticeras* (*Negreliceras*) sp. nov. aff. *subnegreli*, Djanélidzé.
23. ,, ,, ? sp. ind.
25. *Blanfordiceras* cf. *wallichi* (Gray).
28. ,, cf. *boehmi* (Uhlig).
31. *Subthurmannia media*, sp. nov.
33. ,, *lissonioides*, sp. nov.
34. ,, *fermori*, sp. nov.
35. ,, sp. ind.
36. ,, sp. ind. cf. *lorensis* (Lisson).
45. *Himalayites* (?) sp. ind.

[1] Spelt "Makarwal" in the sketch-map on p. 125.

46. *Himalayites* ? (Gen. nov. ?) sp. ind.
54. *Parandiceras* sp. nov. ind.
55. ,, ? cf. *theodorii* (Oppel).
60. *Neocomites* sp. nov. aff. *platycostatus*, Sayn.
62. ,, sp. nov. ind. cf. *noriciformis* (Hohenegger MS.), Uhlig sp.
64. ,, (?) sp. ind. cf. *scioptychus* (Uhlig).
66. ,, (*Lyticoceras* ?) sp. nov.
69. *Kilianella asiatica*, sp. nov.
71. ,, *besairiei*, sp. nov.
81. *Distoloceras* (?) sp. ind.
84. *Hibolites pistilliformis* (Blainville).

Eleven of these species were not found at locality 687 (*a*, above) and they include such characteristic elements as *Negreliceras* and *Parandiceras*, suggesting the presence of additional horizons within the Infra-Valanginian and Valanginian, but due, perhaps, merely to accidents of collecting. From Mr. Pinfold's collection, the following may be added :—

7. *Olcostephanus fascigerus*, sp. nov.
33. *Subthurmannia lissonioides*, sp. nov.
73. *Sarasinella uhligi*, sp. nov.
80. *Neohoploceras* (?) sp. ind.

There are also many unidentifiable fragments of ammonites, a *Pecten*, a *Pholadomya*, a *Rhynchonella*, all badly preserved, and 20 Spiti Shales Perisphinctids, among them the original of Pl. XV, figs. 8*a,b*. Their preservation is the same as in all the other assemblages and there seems to be no doubt that the fragments and nodules were derived from some pre-existing deposit.

The limestone below the Belemnite Shales, at South Miranwal Nala, however, has yielded four ammonites which, in spite of their execrable state of preservation, require discussion, because they may help to establish the exact age of the Jurassic limestone. Two of the four ammonites are figured in Pl. XI, figs. 7*a-d*, and it will be seen that the long and short ribs, continuous across the periphery, are very irregular, some being unusually thick or even split up on the venter. This type of ribbing is found only in a few stocks. The most obvious seemed to be that to which belongs the ammonite from west of Sheikh Budin figured in Pl. VIII, figs. 7*a,b*, namely the group of *Acanthohoplites bigoureti* (Seunes)[1] of the Clansayes horizon (lowermost Albian) and of identical preservation. But at Sheikh Budin, the Lower Cretaceous is far more fully developed than in the Salt Range proper and Mr. Morris collected some large examples of Upper Aptian *Tropaeum* (*bowerbanki* group) from about 650 feet above the base of the Belemnite Beds. The *Acanthohoplites* (Pinfold Coll.), therefore, must have come from higher still. Moreover, there are important differences, such as the presence of lateral tubercles and the fact that the finer ribs are as long as the coarse costae, not intercalated, as in the form from the limestone below the Belemnite Shales. Among Jurassic ammonites, the thickening or ventral duplication of certain ribs is almost unknown. I can think of only one stock with similar ribbing and that

[1] Note sur quelques Ammonites du Gault. *Bull. Soc. géol. France* (sér. 3), Vol. XV, p. 566 ; Pl. XIV, figs. 3-4 (*Acanthoceras*) (1887).

is the group of *Perisphinctes dhosaensis*, Waagen[1] (*Hubertoceras*, Spath) and before I returned to Calcutta the hundreds of Kachh examples I had for description, I again compared them with the two Salt Range specimens here figured. The comparison was indecisive, in view of the preservation of the latter specimens, but at least I found that thickening of some of the ribs actually occurred in *Hubertoceras* though perhaps no ventral duplication. In the circumstances I can only suggest that they are of *anceps* age, one of the other two ammonites being possibly a fragment of a *Reineckeia*, though neither umbilical tubercles nor venter are preserved. Two belemnites from the same limestone, including a slender *Hibolites*, unfortunately are quite inconclusive.

After the above was written I received (with the second consignment) a set of seven ammonites, said to be from the Belemnite Beds of Miranwal Nala, Makerwal, but identical in preservation with the forms from the Jurassic Limestone just mentioned. Fortunately they are clearly recognisable and include—

Hubertoceras spp. (5).

Obtusicostites sp. juv. (Plate XVII, fig. 9).

Kinkeliniceras sp. ind. (Plate XVIII, fig. 2).

There can thus be no longer any doubt that the age is Upper Callovian, but a conglomeratic limestone which underlies the Belemnite Beds for example at a spot 2½ miles E. S. E. of Daud Khel Railway Station (Salt Range) and which contains belemnites and pelecypods is probably of much later age (see p. 124).

(h) A number of ammonites in the second consignment (numbered K. 35/50-K. 35/59) and forming the next assemblage were marked **North Branch of Miranwal Nala, near Makerwal (loc. 50).** They are essentially the same as 682 above, and were associated with a typical Spiti Shales (Chidamu) form of *Aulacosphinctoides*.

3. *Olcostephanus salinarius*, sp. nov. and vars.
5. ,, cf. *globosus*, sp. nov.
7. ,, *fascigerus*, sp. nov.
9. ,, cf. *sublaevis*, sp. nov.
17. ,, (*Rogersites*) *schenki* (Oppel).
23. *Spiticeras* (*Negreliceras* ?) sp. ind.
34. *Subthurmannia* cf. *fermori*, sp. nov.
36. ,, sp. ind. cf. *lorensis* (Lisson).
59. *Neocomites similis*, sp. nov., var. *inaequalis*, nov.
66. ,, (*Lyticoceras* ?) sp. nov.
79. *Neohoploceras* sp. nov.

(i) Miranwal Gorge, Makerwal (No. 690).

The only species is—

66. *Neocomites* (*Lyticoceras* ?) sp. nov.

associated with a *Rhynchonella* (to be described by Dr. H. Muir-Wood) and two Spiti Shales *Aulacosphinctoides* fragments, one of them here figured (Pl. XI, fig. 6). The specimens were marked: From lower part of Belemnite Shale, closely associated with the uppermost Jurassic limestone, but the ammonite figured in Pl. XVII, figs. 2*a*, *b*, like a comparable Teschen species, looks a typically Valanginian element.

[1] Jurassic Fauna of Kachh, Vol. I, fasc. 4; *Pal. Indica*, Ser. IX, Pt. 4, p. 149, Pl. XXXVIII, figs. 4*a*, *b* (1875).

(j) ¾ mile west-north-west of Mallakhel, Makerwal (No. 700).

The list includes only five species—

31. *Subthurmannia media*, sp. nov.
31*a*. ,, ,, ,, (transition to *S. lissonioides*, sp. nov.).
53. *Parandiceras rota*, sp. nov.
54. ,, sp. nov. ind.
57. *Thurmannites* (*Kilianella* ?) sp. nov.
57*a*. ,, ,, ,, finely ribbed var.
68. *Neocomites* (*Calliptychoceras* ?) *pseudovicarius*, sp. nov.

but at Baroch Nala, Mallakhel, Mr. Morris collected in addition—

36. *Subthurmannia* sp. ind. cf. *lorensis* (Lisson).
41. ,, *filosa*, sp. nov.
62. *Neocomites* sp. nov. ind. cf. *noriciformis* (Hohenegger MS.), Uhlig sp.

and at Mallakhel—

54. *Parandiceras* sp. nov. ind.
67. *Neocomites* (*Odontodiscoceras* ?) sp. ind. cf. *montanus*, Uhlig.

A detailed section kindly sent me by Mr. Morris shows that at Mallakhel the Cretaceous (between the sharp break at the top of the Upper Jurassic limestone and the base of the Nummulitic) is 600 feet thick, but only the lower 150 feet are "Belemnite Beds", with occasional isolated belemnites and lignite fragments in the lower half. The abundance of belemnites (and the occurrence of occasional ammonites) is apparently confined to the very base. The 450 feet of sandstones with coal, succeeding the glauconitic Belemnite Beds, apparently have not been definitely dated within the Cretaceous, but judging by the sections at Sheikh Budin are probably also Lower Cretaceous.

Since the ammonites at Mallakhel are confined to the very base of the Belemnite Shales some interesting forms in the Wynne collection from that place may be noticed. The labels are contradictory, as already mentioned in the descriptions, but the ammonites include—

1. *Pterolytoceras* (?) *punjabense* (Folgner MS), sp. nov.
? *Olcostephanus* sp. (*O. guebhardti*, Kilian *in* Folgner).
30. *Blanfordiceras* (Gen. nov.?) sp. nov.

in addition to a few belemnite fragments and the phragmocones discussed under *Belemnopsis gerardi* (No. 82). This seems to make it certain that the unique Lytoceratid is not out of the Jurassic limestone below the Belemnite Beds.[1]

The assemblages from the Salt Range proper (Cis-Indus) are small and less numerous than those listed above. They include:

(k) Slopes about ¾ mile south-west of Khairabad, Daud Khel (No. 673).

The only ammonites recorded, accompanied by *Hibolites pistilliformis* are

[1] After this work was already in proof I received another small consignment of fossils from the lower part of the Belemnite Shales of Baroch Gorge, west of Mallakhel (Nos. K 40/157-162), including many defective belemnites, a large phragmocone, an *Inoceramus*, and the following ammonites:—

4. *Olcostephanus*, sp. ind. cf. *drumensis* (Sayn MS.) Kilian
35. *Subthurmannia* sp. ind.
55. *Parandiceras* (?) *theodorii* (Oppel)
68. *Neocomites* (*Calliptychoceras* ?) *pseudovicarius*, sp. nov.

These were again accompanied by a (derived) fragment of a Spiti Shales species of *Aulacosphinctoides*, comparable to the Form figured in Plate XV, fig. 8.

9. *Olcostephanus sublævis*, sp. nov.
25. *Blanfordiceras* aff. *wallichi* (Gray),

the former figured in Plate III, fig. 3. They are preserved in sandy (and phosphatic ?) limestone (nodules ?), but probably did not come out of the same bed.

(l) ¾ mile E. of Khairabad (loc. 781) from the "middle part of the Belemnite Shales, above the basal *Rhynchonella*-bearing sandstones".

Again only a single ammonite, the Valanginian

Olcostephanus cf. *sublævis*, sp. nov.

was found, accompanied by three accidentally flattened belemnite guards, but from the basal green sandstone itself (resting on light grey, top Jurassic limestone) at the same locality (marked "at junction of three streams, W. of point 1184 and ¾ mile E. of Khairabad") there are only two belemnite fragments, apparently again *Hibolites subfusiformis* (Raspail). From

(m) Gorge 3½ miles south-east of Daud Khel Railway Station (No. 678) there are a few more ammonites and belemnites (also crypts of *Lithodomus*)

3. *Olcostephanus salinarius*, sp. nov.
27. *Blanfordiceras* cf. *acuticosta* (Uhlig).
28. *Blanfordiceras* cf. *bœhmi* (Uhlig).
47. *Protacanthodiscus* (?) sp. ind.

an assemblage which is of interest because some of the fragments are limonitic and resemble those listed below from **p**. It may be remembered that Koken[1] had recorded small examples of *Hoplites neocomiensis* from Daud Khel (Daod Khel), pyritised and burnished like those from the Valanginian of the South of France and of surprisingly similar facies. Since neither the assemblage here listed nor that from **p** includes a pyritic *Neocomites*, and since the faunas are undoubtedly different from the fauna of the Valanginian marls described by Sayn (1907), it is possible that limonitic (originally pyritised) ammonites occur at several horizons.

(n) 2½ miles east of Dher Umaid Ali Shah (Lat. 32° 50′; Long. 71° 37′ 45″) **Pai Khel (No. 675).**

Only one ammonite is recorded

59. *Neocomites* sp. nov. ? cf. *similis*, sp. nov.

but the two fragments, preserved in shiny brown phosphate in a greensand, are doubtful and inconclusive.

(o) Bazar Wahan at Lalumi, Sakesar, Salt Range (loc. 763) from a green sandstone (Belemnite Beds), below basal Nummulitic laterite.

The 16 belemnites from this locality include the original of Plate XXIV, fig. 5 and are apparently all referable to *Hibolites subfusiformis* (Raspail).

(p) Inlier 1½ miles south-west of Sokan, Nawan (Nos. 680 and 768) marked "Glauconitic shales and sandstones (Belemnite Beds), overlying top of Jurassic". The label states that the brachiopods (to be described by Dr. H. Muir-Wood) came from the base of the series, just above the Jurassic limestone. This does not suggest for the fossils listed below an occurrence different from that of the other ammonites here described from the Belemnite Beds. Yet the

[1] *Centralblatt*, p. 443 (1905).

assemblage is so different from the other faunas above listed, except, possibly **m**, that I at once took it to be Tithonian. The assemblage consists of :—

19. *Proniceras indicum*, sp. nov.
20. *Proniceras* sp. ind.
21. *Spiticeras* (?) sp. ind. juv.
24. Gen. nov. ("*Aulacosphinctes*" ?) sp. ind. nov. ?
25. *Blanfordiceras* aff. *wallichi* (Gray).
26. *Blanfordiceras*, sp. nov. ?
27. *Blanfordiceras* cf. *acuticosta* (Uhlig)
28. *Blanfordiceras* cf. *bœhmi* (Uhlig).
29. *Blanfordiceras* aff. *latidomus* (Uhlig)
30. *Blanfordiceras* (Gen. nov. ?) sp. nov.
44. *Himalayites* cf. *seideli* (Oppel)
47. *Protacanthodiscus* (?) sp. ind.
48. *Neocosmoceras*, sp. nov.
49. *Neocosmoceras* sp. ind. cf. *sayni* (Simionescu)
52. Gen. nov. (*Neocosmoceras* ?) sp. ind.
82. *Belemnopsis* cf. *gerardi* (Oppel) Uhlig sp.

Only six species of this list have been recorded from other localities and since the specimens from these are not so well preserved as the small limonitic examples from **p**, it could be held that there is some doubt about the identifications. But the Perisphinctid described as Gen. nov. ("*Aulacosphinctes*") sp. ind. nov. ? seems Jurassic, not to mention the *Proniceras*. On the other hand four of the species now listed are associated at **m** with an undoubted *Olcostephanus* ; another, at **g**, with *Negreliceras*, and two species of *Olcostephanus* ; and the glauconitic original of Plate VI, fig. 1, from **a**, some 25 miles away, undoubtedly very close to if not identical with the forms from **p**, has only two companions of possibly pre-Cretaceous age (among 140 ammonites). Of course, at **p** also, as at many of the other localities, some fragments of Jurassic Spiti Shales *Aulacosphinctoides*, in the usual preservation (a compact marl of a peculiar, yellowish gray) occurred together with the limonitic ammonites and these *Aulacosphinctoides* belong to an earlier fauna still, as does the associated *Hildoglochiceras* cf. *propinquum* (Waagen), figured in Plate XVIII, fig. 8. It could thus be suggested that the assemblage from **p** represents a selection of ammonites, derived from pre-existing deposits, which became incorporated in the Belemnite Marls, but that the age of the latter, as determined by the youngest elements, *e.g.*, *Olcostephanus*, is undoubtedly Cretaceous. Only, the limonitic ammonites apparently are not actually from the base of the Belemnite Beds, but occurred within the lower part of the glauconitic series, so that it is probable that the base of this is not on a uniform level at the different localities. It also seems that the Upper Jurassic limestones, on which the glauconitic series rests unconformably, vary from place to place ; for example, the *Nerinea* limestone of Central European facies, and with a corroded surface, seen by Koken at Daud Khel, is probably different in age from the white calcareous sandstone of Miranwal, Makerwal, that yielded the two *Hubertoceras*, *Obtusicostites* and *Kinkeliniceras* here figured. But it should be mentioned that a conglomeratic limestone which marks the top of the Jurassic, immediately below the glauconitic sandstone of the Belemnite Beds at a neighbouring locality (about $2\frac{1}{2}$ miles E. S. E. of Daud Khel Railway Station) in addition to

unrecognisable belemnites and pelecypods contains many concretionary lumps of limonite and may well be the source of the limonitic Tithonian fauna[1] here discussed.

In any case the equivalent of the Chidamu Stage of the Spiti Shales has been denuded away completely, to leave only a few fragments of almost identical Perisphinctids at almost all the localities. The older elements of the Lochambel stage like those from locality **p** (680) seem to be mixed with undoubted Valanginian ammonites in a number of the assemblages here listed and even at **a** (locality 682) two forms of *Olcostephanus* were found "near the base" of the Belemnite Shales. The latter are highly glauconitic, generally crowded with belemnites, and the badly preserved fossils are often corroded or phosphatised, so that the deposit is clearly condensed, including forms from a number of horizons within the lowest Cretaceous, though not necessarily all.

The belemnites from the same locality **p** (K35/769), though including two examples of *Belemnopsis gerardi* (Oppel) Uhlig, here figured (Plate XXIV, figs. 11 and 13) are mostly *Hibolites subfusiformis* (Raspail).

(q) **About 3½ miles south-west of Nawan, Salt Range (loc. 776),** in glauconitic shales and sandstone beds (Belemnite Beds), just below the Nummulitics, only 13 belemnites were found. Here also *Belemnopsis gerardi* (Plate XXIV, fig. 12) and several examples of the form figured in Plate XXIV, fig. 14 were associated with *Hibolites* aff. *subfusiformis*, some of them illustrated in Plate XXIV, figs. 6-8, but the typical, slender form of the great majority of assemblages is conspicuously absent.

Since the localities are not listed in a geographical order, the following sketch map may be found useful by those unfamiliar with the Salt Range and its Trans-Indus extension.

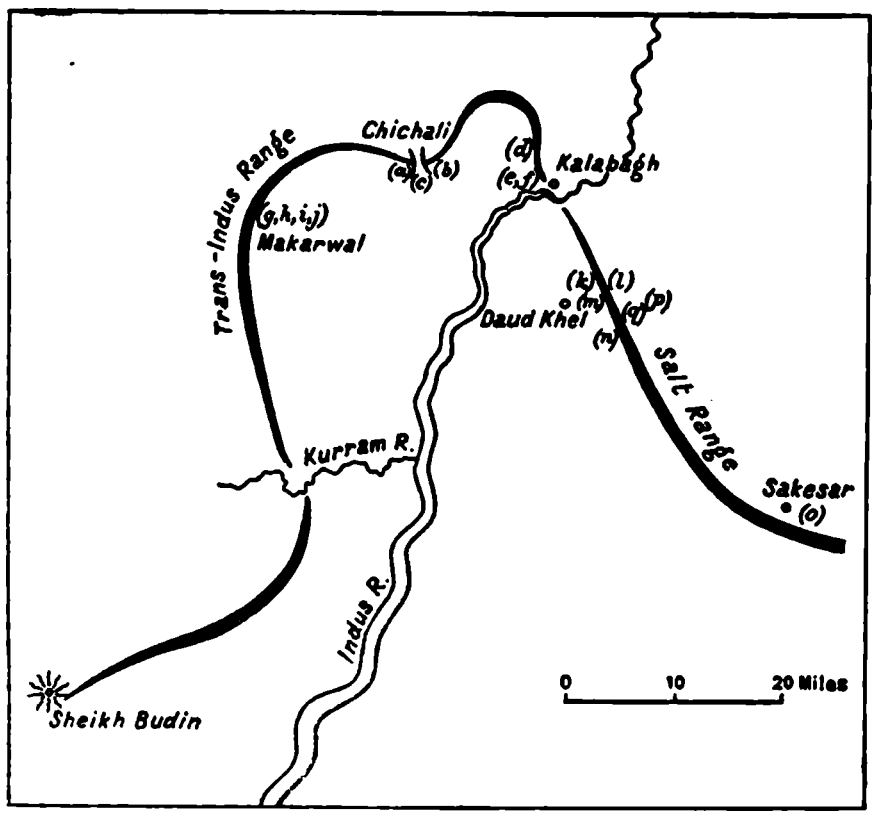


FIG. 1.—Sketch map of Salt Range and its Trans-Indus extension, Punjab and North-West Frontier Province.

[1] After writing the above, I saw the descriptions and figures of a Tithonian fauna from Madagascar by H. Besairie (*Mém. Acad. Malgache*, fasc. xxi, pp. 135-137, pl. xi, figs. 9-34, 1936) and it struck me at once that this was the only assemblage comparable to that from *p*.

IV.—STRATIGRAPHICAL RESULTS.

(a) General.

When discussing, on previous occasions, the condensed remnants of Albian deposits of the Samana and Hazara ranges[1] and the fragmentary Mesozoic beds of the Attock District[2] and the Himalayan area generally, I stressed the variable nature of the deposits of each locality and the incompleteness of the Jurassic and Cretaceous records as a whole. The differences noted in the last chapter between the condensed assemblages from the Salt Range and the far more complete sequence at Sheikh Budin prepare us for a similar variability in the Belemnite Shales; but it may come as a surprise to some to find that even between Daud Khel to the east of the Indus and Chichali to the west, only 20 miles away, the beds and faunas have so much changed. Before discussing these changes, however, it is desirable to review the ammonite genera from the stratigraphical point of view, and to discover which of the elements are reliable for exact dating. As already mentioned, the ammonites are often condensed into the base or at least into the lowest part of the Belemnite Shales and thus may wrongly suggest homogeneous assemblages. Few will still doubt the importance of condensation; those who are interested in the problem and in the study of correlated phenomena like the formation of glauconite and of phosphatic nodule beds will find a wealth of useful information in a recent work by Heim and Seitz.[3]

In the present state of our knowledge of the Salt Range, however, it is difficult to realise the complicated geological events that continually changed the ancient shore lines and that determined the differences in the successions and in condensation at the different localities. Temporary connexion with neighbouring basins of sedimentation, *e.g.*, the Spiti Sea, must have resulted in an intermixture of faunas at different levels; separation occurred at others; differences in depth of water, currents, etc., and general differences of facies must have changed the local faunas. Like all the other "great" transgressions in geological history, not based on the patient working out of the changes from zone to zone, but on far-reaching generalisations, the Neocomian transgression in the Salt Range was probably a succession of small, local events. The rich and varied ammonite fauna, ever present in the seas of the equatorial belt, came in, with its typical elements, in successive waves; it occasionally developed a local tribe that did not spread elsewhere, but such elements do not obscure the general succession of ammonite faunas, safely established. The determination of the exact age of the ammonites here described thus becomes a matter of great importance.

(b) Chronological Value of the Ammonite Genera.

The unique Lytoceratid, like the forms of *Hibolites*, may be left out of consideration, likewise *Neolissoceras grasianum* (d'Orbigny) which has a long range,

[1] *Pal. Indica*, N. S., Vol. XV, Pt. 5, pp. 64-66 (1930).

[2] *Pal. Indica*, N. S., Vol. XX, Mem. 4, pp. 30-38 (1934).

[3] Die Mittlere Kreide in den helvetischen Alpen von Rheintal & Vorarlberg und das Problem der Condensation. *Denkschr. Schweiz. Naturf. Ges.*, Vol. lxix, Abh. 2 (1934).

and *Belemnopsis gerardi* (Oppel) which seems to persist into the Cretaceous (and perhaps gradually passes into *B. africana*, Tate sp.) but which is, undoubtedly, common only in the Upper Jurassic. *Olcostephanus*, the commonest ammonite genus in the Salt Range, is far more important and must be discussed in detail, It occurs at several horizons. Most of the examples and especially all those before me that were referred to *O. salinarius*, on account of their more favourable preservation, colour and mode of mineralisation, can be attached to the highest horizon represented, namely the Upper Valanginian, corresponding approximately to the "*Astieria*" Marls of the Jura Mts. Contrary to Folgner I can see nothing of Hauterivian affinity in the collections before me. Apart from genera like "*Leopoldia*" and "*Acanthodiscus*", which are now interpreted differently, "*Crioceras*", due to a misidentification, and "*Schloenbachia*", based on a derived Jurassic ammonite, certain forms of *Olcostephanus* may have suggested to Folgner a Hauterivian age for at least part of the Salt Range deposits. But the resemblance is general, not specific, and there is not a single ammonite that shows affinity with the *Olcostephanus astierianus—O. jeanneti* assemblage of the lowest Hauterivian or the succeeding *Subastieria* fauna of the Upper Lyticoceratan.[1]

But *Olcostephanus* appeared earlier than the Upper Valanginian "*Astieria* zone" (Baumberger) above mentioned, and Kilian,[2] for example, cited *O. perinflatus* (Matheron) from the next lower zone of *Saynoceras verrucosum* (d'Orbigny), while *O. drumensis* (Sayn) has been recorded from a still earlier level (zone of *Kilianella roubaudiana*, d'Orbigny sp.). It is not possible to distribute the Salt Range forms of *Olcostephanus* among these three zones. A few of the examples, *e.g.*, the originals of Plate IV, fig. 3 and Plate VI, fig. 8, are corroded and preserved in the dark green, intractable matrix of what Folgner called the lower set of beds (p. 118); but other specimens of the same species show the preservation of the forms from the typical *schenki* zone (*i.e.*, the "*Astieria*" beds) so that there must have been considerable condensation of the deposits and their fossils in the Salt Range. I may add that in Mexico, Burckhardt[3] also has been able to recognise three successive "*Astieria*" horizons in the Upper and Middle Valanginian, but on account of the defective preservation of his fauna as well as mine, I have not been able to correlate them satisfactorily.

There is a still earlier group of forms of *Olcostephanus* (*O. polytroptychus*, Uhlig *non* Djanélidzé, and allies) which is transitional to *Negreliceras* and therefore *Spiticeras*. The latter is doubtfully represented by a fragment which does not resemble any Cretaceous species of this genus; *Negreliceras*, on the other hand, is recorded from the Makerwal area and definitely points to the presence of the *boissieri* zone since Djanélidzé has shown that *Kilianiceras gratianopolitense* (Kilian) is the only Spiticeratid to range up beyond the Infra-Valanginian. But *Negreliceras* does not seem to occur at Chichali where *Subthurmannia* is so common, and the question arises as to whether there is a difference in the

[1] See Spath: (*Geol. Mag.*, Vol. lxi), table to p. 80 (1924); also *Pal. Indica*, N. S., Vol. XV, Pt. 5., p 59 (1930).

[2] *Lethaea mesozoica*, Bd. III, 1, fasc. 2, table to p. 202 and pl. III, fig. 2 (1910).

[3] *Bol. Inst. Geol. Mexico*, No. 42, table to p. 40 (1923). (The "*Polyptychites* sp." of the Lower Valanginian appears to be a *Spiticeras*.)

date of existence of these two genera. Kilian[1] divided the *boissieri* zone or Infra-Valanginian into three subdivisions of which the uppermost—a passage horizon into his Middle Valanginian—was characterised by species of *Duvalia*, a belemnite genus unknown from the Salt Range, but found in Waziristan and Baluchistan. The two lower divisions were adopted by myself[2] as the *boissieri* and *callistoides* zones; and *Negreliceras* is an element of the former, according to Kilian. The Cretaceous forms of Olcostephanidae, here described from the Salt Range, may then be dated as follows; incidentally the occurrence of such masses of often large examples of *Olcostephanus* in the Indian-Madagascan area does not support Stolley's[3] views concerning the northern origin of "*Astieria*".

Upper Valanginian	*schenki* zone	*Olcostephanus schenki*, *O. salinarius*, etc.
	verrucosum zone	*Olcostephanus glaucus*, *O. sublævis*, etc.
Middle Valanginian	*roubaudiana* zone	
Lower Valanginian	*gratianopolitense* zone	....
Infra-Valanginian	*boissieri* zone	*Negreliceras* spp.
	callistoides zone	....

It must not be supposed that this is anything like a complete representation of the zones of the lowest Cretaceous; for it is improbable that the *roubaudiana* zone includes more than perhaps the top of the *Dichotomites* beds, so that the greater part of the *Dichotomites* and *Valanginites* beds, and the whole of the *Polyptychites* zones and the Platylenticeratan age of my 1924 table may have to be inserted between the *roubaudiana* and *gratianapolitense* zones.

Among the Berriasellinae, the genera *Blanfordiceras* and *Subthurmannia* are both important for exact dating of the beds. For the former is essentially Tithonian and is not likely to range high up into the Neocomian. When not derived, it is probably everywhere confined to the *Subthurmannia* beds or the lower Infra-Valanginian. *Subthurmannia* is so close to *Substeueroceras* (group of *S. koeneni*, Steuer sp.) that fragments like that here figured in Plate XXI, figs. 2*a*, *b* might easily be identified with it specifically. Now in the Argentine Andes, *S. koeneni* characterises the second of three supposed Lower Valanginian zones[4] which have all been placed below a zone in which *Paradontoceras callistoides* (Behrendsen) is said to be found. But allied forms also occur in that zone, *e.g.*, *Substeueroceras subfasciatum* (Steuer) and *S. rotundatum* (Steuer),[5] the latter almost a *Subthurmannia*, with its suggestion of umbilical tubercles. It is probable therefore that the four zones of Gerth's *Steueroceras* beds are intimately connected, and since they are all below the *Spiticeras damesi* beds they cannot be higher than the *callistoides* zone of Kilian. Excluding the lowest of all (zone of *Lytohoplites burckhardti*, Mayer-Eymar sp.) which appears

[1] *Lethaea mesozoica*, Vol. III, 1, fasc. 2, p. 189 (1910).
[2] *Geol. Mag.*, Vol. LXI, table to p. 80 (1924).
[3] *N. Jahrb. f. Min. etc.*, Beil. Bd. 73, B, p. 390 (1935).
[4] See Gerth: *Steinmann Festschrift* p. 483 (1926).
[5] See Gerth: *Act. Acad. Nac. Cienc., Cordoba*, Vol. IX, Pl. V, fig. 6; Pl. VI, fig. 5 (1925).

to be uppermost Tithonian, the three remaining zones may, in fact, be considered to be mere subzones of a larger *callistoides* zone. Moreover, *Reineckeia fraudans*, Steuer, not easily recognised from the illustration, but characteristic of the next higher zone in Gerth's Middle Valanginian has been described by him[1] as similar to *Subthurmannia rarefurcata* (Pictet); and if this is at all apt, the *fraudans* and *damesi* zones of the Andes could well be correlated with the *boissieri* zone of the above table. But since the next higher zone of *Steueroceras transgrediens* is already of Lyticoceratan age, *i.e.*, basal Hauterivian, there would appear to be no true Valanginian at all in the Andes, which might explain the absence of forms of *Olcostephanus*.

In any case, *Subthurmannia* is confined to the Infra-Valanginian and since the majority of the Salt Range species are more primitive than *S. boissieri* (Pictet) itself, it may well be taken to characterise the lower half of that stage. *Raimondiceras* (*?*) *salinarium* is probably of about the same age.

The range of *Himalayites* has already been discussed on p. 116. If Gerth, however, was wrong in putting his *Himalayites* zone (so-called zone of "*Thurmannia*" *fraudans*) at the top of the Middle Valanginian, as I suggested above, and if this is merely one of the subdivisions of the lowest (*callistoides*) zone, the range of *Himalayites* also becomes restricted to the very base of the Cretaceous and top of the Tithonian. Uhlig,[2] it may be remembered, held that this genus was totally unknown in the true Lower Neocomian or Valanginian, although he recorded two species from the Lochambel Beds of the Spiti Shales. Like *Blanfordiceras* of the same beds, *Himalayites* may just have transgressed the Jurasso-Cretaceous border, to become extinct in the Lower Infra-Valanginian, but in the Belemnite Beds of the Salt Range it also could be derived.

The genus *Neocosmoceras* is less completely known and may include heterogeneous elements, but its range is apparently similar to that of the two genera just mentioned. The small limonitic forms of the Salt Range, like their associates, are probably Tithonian, but the two large species (Nos. 50 and 51) here described, are apparently from the Infra-Valanginian, although, unfortunately, they cannot be compared with any forms described from outside the Salt Range.

Parandiceras is an element known from the Spiti Shales (Lochambel Beds) and Uhlig thought *P.* (*?*) *theodorii* (Oppel) to be so far removed from the primitive Hoplitids of the Berriasian that he ascribed it to the Valanginian. *Parandiceras* is unknown from the Chichali area which has yielded by far the best part of the collections before me, but, like *Negreliceras* already discussed, it occurs in the Makerwal district. It is almost certainly earlier than the *roubaudiana* zone of the table on p. 128; and since it is associated with Neocomitids that can best be compared to forms of the Upper Teschen Shales, I am tentatively referring the genus *Parandiceras* to the Lower Valanginian. As it may be convenient to have a name for this zone, I am suggesting the designation *gratianopolitense* zone, although there is as yet no definite proof

[1] *Steinmann Festschrift*, p. 477 (1926).
[2] *Denkschr. k. Akad. Wiss., Wien*. Vol. LXXXV, p. 547 (1910).

that the Fontanil limestone is earlier than the *roubaudiana* zone. I have already referred to the gap which I believe to exist between these "zones".

Thurmannites begins in the same beds, but, as interpreted by Sayn, it has its maximum development in the *roubaudiana* zone or the Middle Valanginian. It is not always easily separated from its direct successor *Neocomites* which ranges up into the *verrucosum* zone. But, as here interpreted, *Neocomites* includes a very comprehensive assemblage of forms; and species like *N.* (?) sp. ind. cf. *scioptychus* (Uhlig) or *N.* (*Calliptychoceras* ?) *pseudovicarius*, sp. nov. are probably of Lower Valanginian age, while *N.* (*Lyticoceras* ?) sp. nov. cannot be taken to indicate a higher level than the other species here described, any more than the equally doubtful *Distoloceras*.

There remain the genera *Kilianella*, *Sarasinella* and *Neohoploceras* and they clearly belong to the Middle and Upper Valanginian of Kilian. Their preservation is the same as that of the species of *Olcostephanus*, discussed on p. 127; and they are so intimately connected with the European species of the *roubaudiana* and *verrucosum* zones that there can be no doubt about their age, even if forms like *Kilianella pexiptycha* and *Sarasinella campylotoxa* (Uhlig) of the Upper Teschen Shales should appear already in the Lower Valanginian. These genera then are as typical of what I have called the *Neocomites* Beds, as *Subthurmannia* is of the lower set of strata.

(c) Correlation of the Assemblages.

The faunas listed in chapter III may be arranged in three groups. First there are three assemblages from Chichali (*a-c*) and four from the Makerwal area (*g-j*); secondly, seven assemblages (*k-q*) have been listed from localities in the Salt Range proper; and thirdly, three assemblages (*d-f*) are from the neighbourhood of Kalabagh. The last seem to be somewhat intermediate between the other two, but the differences to which reference has already been made are more striking when we compare the assemblages from east of the Indus with those from Chichali and Makerwal to the west. Unfortunately, it is impossible to apply the smaller zones discussed in the last section to the condensed deposits of the Salt Range and the comparison thus must be rather general.

Olcostephanus occurs in typical examples both in the East and West, but it is to be noted that out of 200 examples before me only three are from the Cis-Indus Range. Again *Hibolites subfusiformis* (Raspail) is the commonest belemnite in both areas; yet while the typical slender form is absent, for example, at locality *g*, four out of the five examples of *Belemnopsis gerardi* (Oppel) are from the Salt Range proper. This may be of some significance. Oppel's types of *B. gerardi* came from a ravine north of Kalabagh; and this is precisely the neighbourhood whence came the exception just mentioned, *i.e.*, the fifth example. But as this was accompanied by a large number of specimens of *Hibolites subfusiformis*, it is not certain that its age is not Cretaceous. There is no trace of a *Belemnopsis* from more westerly localities.

The most striking difference in the ammonite faunas is the abundance, in the west, of the large forms of *Subthurmannia* which recall the Infra-Valanginian *S. boissieri* (Pictet) of Europe, and their complete absence from the east; also the occurrence of forms with Tithonian affinities (except, perhaps, some derived fragments) only in the Salt Range proper and, doubtfully, at Kuch (locality *d*), one of the intermediate exposures. It is possible that what has been termed collection failure (Buckman) accounts for apparent differences in the faunas; yet it is clear that the Belemnite Beds must be differently developed in the east and apparently even in the Chichali and Makerwal areas, not to mention Sheikh Budin and other localities still farther west. The information given in the last chapter alone indicates that such differences exist, but I am not in a position to discuss the geological field relations in detail. It must suffice to state that, as already mentioned, in both areas the Belemnite Beds rest unconformably on Jurassic Limestones. From the Makerwal district, undoubted Upper Callovian ammonites are available, establishing the age of the limestone immediately below the Belemnite Shales. The Chichali sections have yielded only the derived fragment of *Putealiceras* figured in Plate XX, fig. 6, but it is of approximately similar age. The exact date of the light grey limestones of the Upper Jurassic at locality *l*, immediately below the basal green Belemnite Beds, is unknown, as is that of the *Nerinea* limestone of European facies, seen by Koken at Daud Khel. But in at least one locality (near *m*), there is a conglomeratic rock, with lumps of limonite (after pyrites), at the top of the Jurassic succession and below the green Belemnite Shales; and it is presumably the denudation of this rock that has yielded the limonitic ammonites of Tithonian aspect that are found in the Belemnite Shales of the Salt Range proper.

Moreover, ammonite fragments and nodules derived from an equivalent of the Chidamu stage of the Spiti Shales have been found in the Salt Range proper as well as at nearly all the localities in the Trans-Indus Range. That the lower beds of the Spiti Shales were once continuous from the Himalayas, through Hazara and the Attock District into Waziristan and even Baluchistan is now established; and the facies is identical throughout, so far as can be judged by the few ammonite remains at present available. During the period that immediately preceded and followed the deposition of the basal Belemnite Beds, there must thus have occurred extensive denudation of Upper Jurassic sediments, but the almost complete absence of Tithonian elements in the Trans-Indus Range (beyond Kuch) shows that this erosion was not uniform. That is to say, as the uneven base itself consisted of rocks of different dates, so the first deposits formed as a result of the Infra-Valanginian transgression differed in the different localities, some of which may not have been submerged till much later. The Tithonian limestone with pyritised ammonites, corresponding to about the middle part of the Spiti Shales, if ever present in the west, must have been denuded to a much greater extent than in the east, where its fossils became incorporated in the glauconitic sands of the Belemnite Beds. Conversely the only ammonite from the Salt Range proper, preserved in the typical bright green glauconitic matrix, is a *Neocomites* which is clearly later in date than the *Subthurmannia* beds of

Chichali and the *Negreliceras* beds of the Makerwal area, the latter yielding a fauna quite unrepresented among the Chichali material studied by Folgner.

Koken's two sections show how in one locality (Daud Khel) the glauconitic marls overlying the Jurassic limestone vary. The only ammonite which may have come from the yellowish-green belemnite marls of Koken's section 3 is a corroded example of *Blanfordiceras* (probably derived) and the description of a specimen of *Olcostephanus* from Khairabad as from "the middle part of the Belemnite shales, above the basal *Rhynchonella*-bearing sandstones" seems to confirm the sequence. But the total thickness of the Neocomian is reduced to about 77 feet as against 197 feet (according to Wynne) at Chichali and 600 feet at Mallakhel (with the lower 150 feet in the facies of Belemnite Shales). From the most easterly locality, Sakesar, there are only a few belemnites, collected from a green sandstone, below the basal Nummulitic laterite, but I am unable to say whether the Belemnite Beds have originally thinned out in this direction or whether renewed denudation carried away most of the Cretaceous before the Tertiary transgression once more invaded the area. The abundance of glauconite, the partial or complete phosphatisation of the fossils and their frequent corrosion indicate a sloping sea floor and current action; and the restriction of the ammonites to the base of the Belemnite Marls shows that condensation took place in the east as much as in the west, so that actual zoning of the beds is impossible. But there is no evidence that the Infra-Valanginian and the Lower Valanginian were ever represented in the Salt Range proper where the Middle or Upper Valanginian may rest upon the Tithonian, and sometimes contain fossils derived from it. Conversely the Lower Valanginian must have been comparatively well developed in the west where, however, the Tithonian is now completely absent, in addition to the rest of the Upper Jurassic, down to the Callovian. It is even probable that the Lower Valanginian succession was more complete at Makerwal than at Chichali, where neither *Negreliceras* nor *Parandiceras* have been collected. But as examples of the latter genus have been found in the intermediate Kalabagh area to the exclusion of elements of the *callistoides* zone, it is improbable that the increase from east to west in the number of zones represented was regular; and, as in all the other fragmentary Cretaceous deposits already cited, each section has to be taken on its own merits.

The representation of the different zones at the principal localities is diagrammatically represented in the following scheme :—

Stages.	Zones.	Makerwal.	Chichali.	Kalabagh.	W. Salt Range.	Sakesar.
Valanginian. Upper	*schenki*	×	×	×	×	?
Valanginian. Upper	*verrucosum*	×	×	×	×	
Valanginian. Middle	*roubaudiana*	×	×	×	?	
Valanginian. Lower	*gratianopolitense*	×		×		
Infra-Valanginian	*boissieri*	×	×			
Infra-Valanginian	*callistoides*		×			

V.—PALÆONTOLOGICAL CONCLUSIONS.

(a) The Composition of the Fauna.

The Cephalopods here described comprise 84 species of which only seven could be definitely attached to known forms. These are listed below; but as they are not helpful for tracing the affinities of the fauna as a whole, 23 further species are discussed, representing forms that have been attached, more or less doubtfully, to ammonites already described in geological literature. Even this leaves 54 species unattached, and of these 29 have been described as new and are comparatively well characterised local elements. The remaining 25 forms are either too fragmentary or too poorly preserved to be named or even compared to known forms. The 81 species of ammonites are represented by over 500 specimens (736 registered numbers) but about 500 belemnite guards and fragments belong almost entirely to the one genus *Hibolites* and chiefly to the single species *H. subfusiformis* (Raspail).

Before discussing the affinities of the cephalopods, it may be advisable briefly to survey the other constituents of the fauna. Bones of reptiles occur, and Folgner apparently had a vertebra of an *Ichthyosaurus* which he considered to indicate the proximity of land. He also listed fish remains (*Strophodus*), but only four pelecypods and one gastropod. The last (*Pleurotomaria blancheti*, d'Orbigny) he considered to point to relationship with the fauna of the western Swiss Jura. The pelecypods (*Astarte herzogi*, Krauss, *A.* sp., *Exogyra imbricata*, Krauss, *E.* aff. *couloni*, d'Orbigny) he thought of interest on account of their close affinity with those of the Uitenhage Beds. Since Dr. L. R. Cox has undertaken the revision of these mollusca, as of the *Pecten*, *Pholadomya* and other elements recorded in chapter III from various localities, they will not now be discussed, nor need I refer to the Rhynchonellids, to be described by Dr. M. Muir-Wood; but it will be seen that the Neocomian fauna consists essentially of cephalopods. I may mention in this connection that Folgner's list included 57 species of ammonites, 19 of which he considered new. This is much the same proportion as that here adopted for the collections as a whole. No fewer than seven species of belemnites, however, were listed by Folgner, including *Duvalia* cf. *grasi* (d'Orbigny). These cannot possibly be represented among the fragments sent to me and there also is nothing that could be the "*Aptychus* (?) ind." of Folgner's list.

Taking the known forms first, the following list shows that three species were created by Oppel especially for Indian types, while the two widely distributed forms of *Hibolites* have already been considered by Noetling to be among the most characteristic elements of the Neocomian Belemnite Beds of Baluchistan.

2. *Neolissoceras grasianum* (d'Orbigny).
17. *Olcostephanus* (*Rogersites*) *schenki* (Oppel).
55. *Parandiceras*(?) *theodorii* (Oppel).
77. *Neohoploceras submartini* (Mallada).
82. *Belemnopsis gerardi* (Oppel).
83. *Hibolites subfusiformis* (Raspail).
84. *Hibolites pistilliformis* (Blainville).

Of the two remaining species, the first (*Neolissoceras grasianum*) is known from France, Switzerland, Germany, Austria, Czechoslovakia, Italy, Spain, Roumania, Bulgaria, Tunis, Algeria, Morocco, and, no doubt, other countries, and therefore not nearly so restricted as the second species (*Neohoploceras submartini*) which is known only from France and Spain. But the following list of forms that have been attached, more or less tentatively, to known species, shows that these also are quite inconclusive.

4. *Olcostephanus* sp. ind. cf. *drumensis* (Sayn MS.) Kilian.
12. *Olcostephanus* cf. *perinflatus* (Matheron).
15. *Olcostephanus* cf. *madagascariensis*, Lemoine.
18. *Olcostephanus* (*Rogersites*) cf. *atherstoni* (Sharpe).
22. *Spiticeras* (*Negreliceras*) sp. nov. ? aff. *subnegreli*, Djanélidzé.
25. *Blanfordiceras* aff. *wallichi* (Gray).
27. *Blanfordiceras* cf. *acuticosta* (Uhlig).
28. *Blanfordiceras* cf. *bœhmi* (Uhlig).
29. *Blanfordiceras* aff. *latidomus* (Uhlig).
36. *Subthurmannia* sp. ind. cf. *lorensis* (Lisson).
44. *Himalayites* cf. *seideli* (Oppel).
49. *Neocosmoceras* sp. ind. cf. *sayni* (Simionescu).
56. *Thurmannites* cf. *pertransiens* (Sayn).
58. *Thurmannites* (?) sp. ind. cf. *pronecostatus* (Felix).
60. *Neocomites* sp. nov. aff. *platycostatus*, Sayn.
61. *Neocomites* sp. nov. cf. *teschenensis* (Uhlig).
62. *Neocomites* sp. nov. ind. cf. *noriciformis* (Hohenegger MS.) Uhlig sp.
63. *Neocomites* aff. *neocomiensiformis* (Hohenegger MS.) Uhlig sp.
64. *Neocomites* (?) sp. ind. cf. *scioptychus* (Uhlig).
67. *Neocomites* (*Odontodiscoceras* ?) sp. ind. cf. *montanus*, Uhlig.
70. *Kilianella* cf. *pexiptycha* (Uhlig).
72. *Kilianella* ? (*Acanthodiscus*) sp. nov. cf. *lamberti* (Sayn).
76. *Sarasinella* aff. *campylotoxa* (Uhlig).

Apart from the extra-European forms, they are compared partly to French, partly to Silesian species, but this is of little significance. For while there is only a single Madagascan form in this list, our comparison, in the next section, of the Valanginian of Madagascar and the Salt Range will reveal a striking affinity; and the complete absence of Crimean species from the list might easily mislead if the difference in date of the deposits be left out of consideration. In comparing the assemblages of the Salt Range with the faunas of other regions, India, of course, is taken first.

(b) Comparison with other Faunas.

(1) India.

Although only nine species have been listed as identical with or allied to forms of the Spiti Shales, the number must be increased by the following species :—

Olcostephanus fascigerus, sp. nov.
Olcostephanus sublœvis, sp. nov.
Kilianella asiatica, sp. nov.

This makes a total of twelve species, or only one-seventh of the whole fauna; but it could easily be increased still more because even the unnamed forms of genera like *Blanfordiceras*, *Himalayites*, *Neocosmoceras*, *Parandiceras*, *Thurmannites* and *Sarasinella* are probably closer to Spiti Shales species than to those from elsewhere. There are, however, important differences. Thus, *Olcostephanus*, undoubtedly the most prolific ammonite stock in the Salt Range and represented by a large number of species as well as individuals, is very rare in the Spiti Shales whence only three species and three specimens have been recorded. Since these include *O.* (*Rogersites*) *schenki* (Oppel) it is perhaps not entirely a question of difference in date of the deposits. Again, *Hibolites* is unknown in the Lochambel Beds. Uhlig, it may be remembered, considered that *Belemnopsis gerardi* (Oppel) which was " distributed throughout the whole of the Lower and Middle divisions of the Spiti Shales ", apparently occurred even in the highest stage; but the only badly weathered fragment he recorded from the Lochambel Beds is doubtful and could still be of Tithonian age. The absence of Neocomian belemnites is all the more surprising since there are numerous Valanginian Neocomitids in the same beds; and even if we allow for gaps in the Salt Range succession, *Hibolites subfusiformis* was extremely abundant throughout all the Lower Neocomian horizons in most Mediterranean-Tethyan areas, from Morocco to Baluchistan.

This shows that there is a difference of facies. Since I have only recently discussed the facies of the Spiti Shales in relation to the deposits of Kachh[1] and of the Attock District[2], it may suffice to point out that the difference could be due merely to the difference between tranquil, open-sea conditions and disturbed, neritic conditions, not necessarily in shallow water, but near a steep and rocky coast. Uhlig[3] held that the Spiti Shales were much like certain other ammonite clays; he characterised them (after Fuchs) as " deep-sea formations " and thought they were " exemplified by the Gault of Folkestone ". This seems to me to be a very doubtful deposit to choose as a typical example of a deep-sea formation. Assuredly there are numerous belemnites and ammonites, and great quantities of *inocerami*; yet not only are the Hamitids and other benthonic crawlers exceedingly abundant, but there are numerous lines of phosphatic nodules, rolled or coated with parasites and occasionally associated with glauconite, marking larger or smaller breaks in the succession, or changes in the submarine erosion level. This is a picture very different from that painted by Uhlig. The Spiti Shales are probably no more a true deep-sea formation than the Gault; and they cannot represent a complete succession from the Oxfordian to the base of the Hauterivian, as Uhlig held. In fact, there is no equivalent of the thousand feet and more of Lower and Middle Kimmeridge Clay of England and there may be great gaps even in the Tithonian and Valanginian parts of the succession. The Gieumal Sandstone into which the Spiti Shales pass and which was to Uhlig the " exact equivalent " of the Hauterivian Grodischt Sandstone of Silesia, is even more fragmentary, as I showed in 1934[4]. There is no evidence whatever

[1] *Pal. Indica*, N. S., Vol. IX, Mem. 2, Pt. 6, p. 804 (1933).
[2] *Pal. Indica*, N. S., Vol. XX, Mem. 4, p. 32 (1934).
[3] *Denkschr. k. Akad. Wiss., Wien*, Vol. LXXXI, p. 565 (1910).
[4] *Pal. Indica*, N. S., Vol. XX, Mem. 4, pp. 33, etc. (1934).

for calling it " an assemblage of beds ranging from Middle Neocomian up to the base, at least, of the Upper Cretaceous ", as Spitz[1] has done, but the only recognisable ammonite he cited is an " *Astieria* " of the *atherstoni* group, still suggestive of the Valanginian *schenki* zone. The change in facies from Spiti Shales to Gieumal Sandstone then probably occurred during the close of the Upper Valanginian, but no belemnites of the genus *Hibolites* appeared. The facies of the glauconitic Belemnite Beds, so widespread in the west of India, from Samana and the Salt Range through Waziristan to Baluchistan, simply was not developed in the Himalayan area. Unfortunately, the fragmentary Cretaceous (so-called Gieumal) deposits of Hazara and the Attock District, previously discussed, which include glauconitic belemnite beds even in the Albian,[2] are too incompletely explored to be compared with the Salt Range sequence.

I may add that Belemnite Beds of Lower Cretaceous age must be well developed and widely distributed especially in South Waziristan, judging by collections of thousands of mostly unidentifiable specimens and fragments sent to me (Dr. A. L. Coulson coll.). They had been assigned in the field to different formations but seem to be of the same type as those here described as *Hibolites subfusiformis* and its var. *baluchistanensis*, notably those from the Nai Kach and (the equivalent) Danawat Formations which are separated from the Upper Jurassic Ladha Shales (with *Virgatosphinctes* of Chidamu age) by a mighty plant-bearing series (Janjal Series). Only a small, doubtful assemblage from the ? Haideri Kach Formation could be higher in the Lower Cretaceous. There are only two or three fragments of *Duvalia*. At one locality (2¼ miles south-east of Pezu, Bannu District, N.-W. F. P.) belemnites of the *subfusiformis* type were accompanied by a *Nautilus* (*Cymatoceras*) and a few Crioceratid fragments resembling apparently undescribed forms (*Hoplocrioceras* ?) from the *Trigonia schwarzi* Beds of Tendaguru.

(2) Madagascar.

The comparison of the Neocomian of the Salt Range with that of Madagascar is more satisfactory because the stratigraphical succession of several distinct though small faunas is known, and some characteristic or even identical ammonites from the two areas can be figured. The Madagascan faunas have already been briefly recorded by H. Besairie[3] and the writer,[4] but may now be discussed in more detail because some of the identifications were provisional, certain names being used uncritically, and because a magnificent new memoir by Besairie[5], just published, contains excellent figures of many new species of Madagascan ammonites.

[1] *Rec. Geol. Surv. Ind.*, Vol. XLIV, Pt. 3, p. 213 (1914).

[2] *Pal. Indica*, N. S., Vol. IX, Mem. 2, Pt. 6, p. 803 (1933).

[3] *Bull. Soc. Hist. Nat. Toulouse*, Vol. LX, fasc. 2, p. 462 (1930). See also: Note sur le Jurassique supérieur et le Néocomien à Madagascar. *Bull. Soc. Hist. Nat. Toulouse*, Vol. lxiv, 1932, p. 182 ; and *Annales géol. Service des Mines, Madagascar*, fasc. 2, p. 43 (1932).

[4] *Pal. Indica*, N. S., Vol. IX, Mem. 2, Pt. 6, p. 824 (1933).

[5] Recherches géologiques à Madagascar. I. La Géologie du Nord-Ouest. *Mém. Acad. Malgache*, fasc. xxi, pp. 259, tables, map, 24 plates (1936).

From the lowest (Infra-Valanginian or Berriasian) assemblage of north-western Madagascar *Kilianella* and *Thurmannites* had previously been recorded. They were said to occur abundantly in the limestone bands in the Belemnite Marls, but they are difficult to extract and apparently mostly body-chamber fragments; the five here figured from 1 km. N. of Ankaramibe, N. E. of Andavaravina (niveau 1) are now referred to :—

Subthurmannia (*Berriasella* ?) sp. (Plate VIII, fig. 5).
Subthurmannia (*Berriasella* ?) sp. (Plate XIV, fig. 3).
Kilianella besairiei, sp. nov. (Plate XVI, fig. 5).
Kilianella sp. nov. (transition from *Berriasella* of the *privasensis* group). (Plate X, fig. 5).
Neocomites sp. nov. cf. *teschenensis* (Uhlig). (Plate XV, fig. 6).

A fine example of the form listed first has now been figured by Besairie (p. 138, Pl. XXIV, figs. 14-15) as *Berriasella* sp., while a fragment of *Kilianella besairiei*, nov. was referred by him (p. 138, Pl. XXIV, fig. 13) to " Cf. *Thurmannites* sp." I was inclined to place this assemblage in the Lower Valanginian on the strength of the last two species, and to consider it later than the Infra-Valanginian beds with *Spiticeras* and " *Acanthodiscus* ", from elsewhere in Madagascar; but the resemblance of three of the Madagascan forms to the *Berriasella* figured by Uhlig from the Spiti Shales, and perhaps also to the *Blanfordiceras* (Gen. nov. ?) sp. nov., represented in Plate XX, fig. 7, from the Salt Range, makes it possible that both assemblages can be accommodated in the Infra-Valanginian, even if they are not contemporaneous. Moreover, *Spiticeras* itself has now been found by Besairie (p. 73) in the first assemblage; and he was thus perfectly correct in calling it " Berriasian in character " and of Infra-Valanginian age.

The belemnites from these beds, recorded by Besairie in 1930, I have not examined; but he has now (1936, p. 73) renamed the characteristic form from these marls (*Hibolites joleaudi*, Besairie) and states that it occurs already in the Tithonian but does not go up into the higher part of the *Duvalia* Marls above. The belemnites from this next higher assemblage (*Duvalia* Marls of N. E. of Andavaravina, niveau 3) I listed as *Hibolites* (various species) and *Duvalia* aff. *polygonalis* (Blainville). The former seemed to me to fall within *H. subfusiformis*, as here understood, and its var. *baluchistanensis*, and they include the example figured in Plate XIX, fig. 1. Since Besairie has far more abundant material than is before me and since he records other species of *Hibolites* from the same beds, I am quite prepared to accept *H. joleaudi* as a new species, but the more massive variety (Besairie's pl. xxii, figs. 7-8) in any case is indistinguishable from d'Orbigny's fig. 9 (pl. iv). Unfortunately, in the absence of ammonites, it is impossible to date this fauna accurately, but there can be no doubt about its Valanginian age. This is established by the assemblage from the succeeding *Rogersites* beds, which is of the greatest interest. A revised list of the cephalopods from these beds, at a hill N. W. of Ambiky (cote 140), is as follows :—

1. *Nautilus* (*Eutrephoceras*) aff. *uitenhagense*, Spath.
2. *Phylloceras tethys* (d'Orbigny), var. (=*P. ambikyensis*, Besairie ?).

3. *Ptychophylloceras* aff. *semisulcatum* (d'Orbigny).
4. *Hemilytoceras* sp. ind. (*liebigi* group).
5. *Uhligites ambikyensis*, Besairie.
6. *Neolissoceras grasianum* (d'Orbigny).
7. *Olcostephanus sakalavensis* (Besairie). Plate V, fig. 5.
8. *Olcostephanus collignoni* (Besairie).
9. *Olcostephanus* sp. juv. aff. *collignoni* (Besairie). Plate V, fig. 4.
10. *Olcostephanus fascigerus*, sp. nov.
11. *Olcostephanus rabei* (Besairie).
12. *Olcostephanus* (*Rogersites*) *schenki* (Oppel), and vars. (Besairie).
13. *Olcostephanus* (*Rogersites*) aff. *atherstoni* (Sharpe).
14. *Olcostephanus* (*Rogersites*) *douvillei*, Besairie.
15. *Olcostephanus* (*Rogersites*) sp. nov. ind. (very large, finely ribbed).
16. *Olcostephanus* (*Rogersites*) *baini* (Sharpe), var. *ambikyensis* (Besairie).
17. *Olcostephanus* (*Rogersites*) *spathi* (Besairie).
18. *Olcostephanus* (*Rogersites*) *tsimihetensis* (Besairie).
19. *Olcostephanus* (*Rogersites*) *quinquestriatus* (Besairie).
20. *Olcostephanus* (*Rogersites*) *curvicostatus* (Besairie).
21. *Thurmannites* (*Neocomites* ?) *madagascariensis* (Besairie). Plate XVII, fig. 7.
22. *Thurmannites* (*Neocomites* ?) sp. ind. juv.
23. *Sarasinella* sp. nov. ? aff. *trezanensis* (Sayn). Plate XVII, fig. 10.
24. *Sarasinella* sp. aff. *trezanensis* (Sayn).
25. *Sarasinella gignouxi* (Besairie).
26. *Sarasinella* (?) sp. nov. (*longi-eucyrtus* group, Sayn ; very large).
27. *Sarasinella sakalavensis* (Besairie).
28. *Neocomites* (?) sp. nov. (group of *N. platycostatus*, Sayn ?).
29. *Neocomites* sp. (with *Taramelliceras*-like outer whorl). Plate XVII, fig. 1.
30. *Neocomites* (*Leopoldia* ?) cf. *quadristrangulatus*, Sayn. Plate XVII, fig. 6.
31. *Neocomites* (*Leopoldia* ?) sp. nov. ? (more coarsely ribbed than last). Plate XVII, fig. 5.
32. *Leopoldia* (Gen. nov. ?) sp. nov. aff. *biassalensis* (Karakasch).
33. *Neohoploceras* aff. *submartini* (Mallada) Besairie.
34. *Neohoploceras jacobi* (Besairie).
35. *Neohoploceras* (?) *provincialis* (Sayn) Besairie sp.
36. *Neohoploceras* sp.
37. *Distoloceras spinosissimum* (Hausmann).
38. *Distoloceras sparsispinum* (Hausmann) Besairie.
39. *Bochianites* sp.
40. *Belemnopsis africana* (Tate). Plate XXIV, fig. 15.
41. *Belemnopsis africana* (Tate), var. fine of Besairie (=*B. madagascariensis*, Besairie MS. ? p. 73).
42. *Hibolites fontoinonti*, Besairie.
43. *Hibolites subfusiformis* (Raspail) var. Plate XXIV, fig. 10.
44. *Hibolites* spp.
45. *Duvalia dilatata* (Blainville).
46. *Duvalia sakalava*, Besairie.
47. *Duvalia emerici* (Raspail).
48. *Pseudobelus* sp. (Besairie).

The only element in this list that might suggest a post-Valanginian age is the "*Leopoldia*" aff. *biassalensis* (Karakasch), but since Baumberger recorded this species from the *Astieria* marls of Villers-le-Lac (Doubs) as well as from the Hauterivian of western Switzerland (Neufchâtel) and since it has been recorded from the Valanginian of N. E. Bulgaria,[1] it is not out of place in the typical *schenki* fauna of Madagascar. Apart from the forms of *Olcostephanus* there seem to be few elements in common with those of the Salt Range here described; but if we add *Hibolites* cf. *subfusiformis* and the species of *Sarasinella*, *Neocomites* and *Thurmannites*, which even if specifically different are yet of the same general type, more than half of the 48 forms listed may be considered comparable. The absence of *Nautilus* from the Salt Range is probably of no significance. Important differences, however, are the abundance of *Phylloceras* and especially of *Lytoceras* in Madagascar, the persistence of the Jurassic ammonite family Oppelidæ, the abundance of *Duvalia* and of *Belemnopsis africana*, and the occurrence of *Distoloceras* and *Bochianites*, characteristic of the Uitenhage beds of South Africa. *Lytoceras*, so common again in the *Trigonia schwarzi* beds of Tanganyika, indicates a difference of facies, probably also the substitution of *Belemnopsis* and *Duvalia* for *Hibolites*. The persistence of *Streblites* (*Uhligites*) is reminiscent of the Spiti Shales, but in the South of France also, according to Kilian[2], *Oppelia zonaria* (Oppel) is still rather common in the Valanginian and *Oppelia* is even said to be represented by several rare species in the Hauterivian. Since the affinity of the fauna of the *Rogersites* beds of northern and north-western Madagascar with that of the far less prolific Uitenhage formation as well as with European assemblages has already been discussed on previous occasions, it may suffice to say that the South African fauna, with its preponderating pelecypods, scarcity of belemnites, and abundance of gigantic *Rogersites*, unknown from elsewhere, represents a special, local facies, different from that of the Belemnite Beds of the Salt Range. A perusal, however, of E. Basse's[3] and H. Besairie's[4] accounts of the Neocomian in the south-west of Madagascar will show that the development differs much in different parts of this huge island and that the belemnite marls of certain localities, when better known, may prove to be even more comparable to the Salt Range deposits here described than the Ambiky assemblage above listed.

(3) East Africa.

When discussing the fragmentary Neocomian faunas of Portuguese East Africa and of Tanganyika on a previous occasion,[5] I cited certain species (*e.g.*, *Rogersites* and *Neolissoceras grasianum*) that are here described from the Salt Range; but I questioned the presence of undoubted Valanginian ammonites or of a marine equivalent of the Uitenhage beds in Tanganyika. In the new collections from the *Trigonia schwarzi* beds of the Tendaguru district there is, indeed,

[1] Tzankov, *Revue Soc. géol bulg.*, Vol. V, p. 91 (1933).
[2] Lethaea mesozoica, Vol. III, 2, pp. 175, 194, 227 (1910).
[3] Etude géologique du S. E. de Madagascar, p. 76 (1934).
[4] *Bull. Soc. Hist. Nat. Toulouse*, Vol. LX, fasc. 2, p. 462 (1930).
[5] Spath, *Ann. S. Afr. Mus.*, Vol. XXVIII, Pt. 2, pp. 133-36 (1930).

a single example of *Olcostephanus* (out of eleven) that resembles the forms of the "*Astieria*" marls (or the *schenki* zone of the present paper); but even this, on account of the rather stronger umbilical tubercles, could also be compared to the true *Olcostephanus astierianus* (d'Orbigny)[1] or to *O. singularis*, Baumberger.[2] The remaining ammonites, especially the species of *Olcostephanus*, *Subastieria* and *Holcodiscus* (described by Krenkel[3] and Zwierzycki[4]), the abundance of *Lytoceras*, *Phylloceras* and of Nautiloids, all indicate the greatest contrast with the Salt Range fauna here described. But the difference I still believe to be one of age rather than facies. Krenkel thought that Valanginian was certainly represented in Tanganyika and he even stated that the Uitenhage beds extended without any doubt into the Hauterivian. Neither of these statements can now be accepted; and Zwierzycki's later list of cephalopods from the *Trigonia schwarzi* beds also does not contain a single form that could not be Hauterivian rather than Valanginian. For example I can see no affinity between *Olcostephanus crassus*, Zwierzycki and *O.* (*Rogersites*) *schenki* (Oppel); *Bochianites janenschi*, Zwierzycki, is widely different from the Uitenhage or Speeton forms of *Bochianites*, and *Hoplites* cf. *neocomiensis* (d'Orbigny) is based on altogether unrecognisable fragments. The succession, moreover, is unlikely to be continuous from the Lowest Hauterivian through the Barremian into the Aptian, and probably includes only very fragmentary deposits of each of these formations. The relations between the East African Neocomian and that of Baluchistan and the Salt Range, discussed by Zwierzycki, then are confined to the presence of a few common belemnite species, not by any means typically Indian forms, nor restricted in vertical range.

Unlike the Tendaguru fauna, then, which is different from that here described because it is of different age, the two Valanginian assemblages known from Portuguese East Africa are too small and fragmentary to be of use for exact correlation.

(4) Persia (Iran).

I have already recorded[5] that there is abundant evidence of the presence of genera like *Berriasella*, *Substeueroceras* and allies in southern and south-western Persia and of a complete succession from the uppermost Jurassic into the Lower Cretaceous. But the ammonites I examined came from disconnected sections, apparently out of an enormous thickness of flaggy compact limestones of a similar texture throughout; and being crushed or preserved merely as impressions they would be difficult exactly to correlate even if their stratigraphical sequence had been established. Unlike the prolific and more favourably preserved Aptian, Albian and Neo-Cretaceous faunas of Persia, most of the presumed Infra-Valanginian forms are not now before me and must be left out of consideration. There is only one small suite, submitted to me some years ago (and

[1] See in Baumberger, *Abh. Schweizer Pal. Ges.*, Vol. XXXVI, Pl. XXXII, fig. 1 (1910).
[2] *Ibid.* (Vol. XXXV), p. 3, Pl. XXVI, fig. 5 (1908).
[3] Die Untere Kreide von Deutsch-Ostafrika. *Beitr. Pal. Geol. Osterr. Ung.*, Vol. XXIII, pp. 201-250, 1910.
[4] *Archiv. f. Biontologie*, Vol. III, No. 4, Pt. 3, p. 83 (1914).
[5] *Pal. Indica*, N. S., Vol. IX, Mem. 2, Pt. 6, p. 831 (1933).

since returned to Persia), which showed a remarkable similarity, even in preservation, to the fauna of the Valanginian marls of the South of France, described by Sayn. Not having kept a record of the identifications, I am unable to discuss this assemblage but I thought it advisable to mention its existence because Koken found a similar pyritised *Neocomites*-fauna at Daud Khel in the Salt Range, also of surprisingly European facies. But while there appear to be Belemnite Beds similar to those of Waziristan and Baluchistan in the south-east, *e.g.*, at Dar Gaz (labelled "Basal Cretaceous Flysch"), and *Duvalia* beds elsewhere, *e.g.*, in the Kan-i-Kal-Zimkan Valley, the only impression of an *Olcostephanus* from south-western Iran before me (L. G. M. 350) seems to belong to a Hauterivian species rather than to one of the Valanginian forms here described. According to Haug[1], the Eo-Cretaceous deposits seemed to be missing entirely in the north-west of Iran (the region of the Araxes River and the Elburz Mts.), but Stahl[2], a few years later, while stating that the Lower Cretaceous was probably extensively developed throughout Persia, recorded a single Neocomitid (*Hoplites* of the group of *H. cryptoceras*, d'Orbigny) in grey, compact limestones from this very area, *i.e.*, the Elburz Mts., north of Teheran.

(5) South-Western Asia.

Little has been added to our knowledge of early Eo-Cretaceous deposits in the countries bordering the eastern Mediterranean and the Black Sea since Haug[3] briefly recorded them in 1907 and Uhlig[4] summarised them in his masterly essays of 1910 and 1911. The latter author thought that Baluchistan perhaps represented the border region between the Indian and the Kimmero-Caucasian Provinces in which "sometimes the western, sometimes the eastern influence gained the upper hand." Neither the belemnites of Baluchistan, however, nor the ammonites of Persia, already discussed, enable us to elaborate this point. Iraq is still comparatively unexplored; in Egypt and Palestine, the Nubian Sandstone is transgressed by the Cenomanian and even in the Jebel Moghara area (Sinai) the lowest Cretaceous deposits are of Barremian age. The Aptian or Albian deposits of Transjordania are doubtful, as is the lower Cretaceous of the Central Lebanon.[5] In other parts of Syria, *Trigonia* beds underlie the Upper Cretaceous and may be of Albian age, but the whole of Asia Minor seems to be devoid of marine Lower Neocomian deposits, that could be compared to those of the Salt Range. The same applies to the Caucasus, south of which range Valanginian sediments have been recorded, but in the facies of white, compact limestones with *Natica* and *Terebratula*.

(6) The Crimea.

It is only in the Crimea that we again meet with ammonites that resemble Salt Range species here described. Folgner indeed had attached or compared

[1] Traité de Géologie, Vol. II, fasc. 2, p. 1220 (1907).

[2] Persien. Handbuch d. regionalen Geologie. Vol. v, Abt. 6, p. 14 (1911).

[3] Traité de Géologie, Vol. II, fasc. 2, pp. 1218 & ff. (1907).

[4] *Denkschr. k. Akad. Wiss.* Wien, Vol. LXXXI,, pp. 572-574 (1910) also *Mitteil. Geol. Ges. Wien*, Vol. IV, pp. 355, &c. (1911).

[5] See Dubertret: Études sur les états du Levant sous mandat français. *Revue de Géogr. phys. et de Géol. dynam.*, Vol. vi, fasc. 4, pp. 3, 290. Also Blake: The Stratigraphy of Palestine, etc. *Publ. Govt. Palest.*, No. 3, Jerusalem, pp. 64-68 (1935).

to Crimean species several of the Neocomitids and Olcostephanids of the Wynne collection, but the identifications have not here been adopted. There appears to be a break in the succession, after the Upper Tithonian, which, at Theodosia, has yielded a fine cephalopod fauna, including *Proniceras* and other forms comparable to those of locality 680 (see under *p* on p. 123). The lowest Cretaceous is characterised by *Alectryonia rectangularis* (Roemer) at some localities, marls with *Duvalia* elsewhere, and deposits without cephalopods at still other localities, between Balaclava in the west and Theodosia in the east. But apart from ammonites like *Kilianella pexiptycha* and *Thurmannites thurmanni*, recorded from the *Duvalia* marls, yet not indicating the Infra-Valanginian, the species that have been compared by Folgner to Salt Range forms come from the basal, sandy-calcareous conglomerate of Biassala. As Karakasch[1] has already pointed out, however, this contains ammonites of higher horizons, that is the Hauterivian, in addition to Upper Valanginian genera, notably *Neohoploceras* and certain Neocomitids. The Olcostephanids, for example, all seem to be later than those of the Salt Range, with the exception of "*Astieria spitiensis*, Blanford," figured by Karakasch.[2] This was a misidentification, as pointed out by Kilian[3] who, like Wegner[4] after him, considered the ammonite to belong to *Olcostephanus atherstoni* (Sharpe). It differs from the type of that species in having coarser ribbing and from *O.* (*Rogersites*) *schenki* in its greater inflation, but it is apparently a *Rogersites* of the *atherstoni-schenki* group and thus indicates the Upper Valanginian. With the possible exception, however, of such a doubtful Neocomitid as the *Hoplites* cfr. *amblygonius* (*non* Neumayr and Uhlig) figured by Karakasch,[5] all the other Crimean forms are of later Neocomian age than the Salt Range forms and thus not comparable. It is not surprising therefore that our list of species does not contain a single form typical of the Crimea.

(7) The Mediterranean Area.

Farther west in the Mediterranean area an increasing number of the comparable forms listed on p. 134 are met with, but this is more or less fortuitous; for not only are these areas more thoroughly explored and their faunas more completely described, but the successions are often more continuous than those of India. Thus the sequence in the South of France has always been regarded as the standard of comparison and it is very natural that species are often compared to the well-known French forms; yet in north-eastern Bulgaria the (reputedly Middle and Upper Valanginian) *Duvalia* marls alone have a thickness of 1350 metres or 4,500 feet[6]. These rest on equally fossiliferous Lower Valanginian and Infra-Valanginian marly limestones or their equivalents in other facies; and when the cephalopod faunas of these deposits are more completely described there will be available for comparison one of the finest Neocomian sequences in

[1] *Trav. Soc. Imp. Nat. St. Pétersb.*, Vol. XXXII, Livr. 5. p. 448 (1907).
[2] *Ibid.*, p. 122, Pl. XXVIII, figs. 8*a*, *b*.
[3] Lethaea mesozoica, III, fasc. 2, p. 214 (1910).
[4] Revision Formes *Astieria* &c., p. 10 (1909).
[5] *Trav. Soc. Imp. Nat. St. Pétersb.*, Vol. XXXII, Livr. 5, p. 86, Pl. XI, figs. 6*a*, *b* (1907).
[6] Die Unterkreide im Ostteil des Preslav-Sattelsystems (Ostbulgarien). *Abh. Sächs. Akad. Wiss. Leipzig*, Math.-phys. Kl., Vol. XLI, No. 5 (1932), p. 78.

the world. But the lists of definitely identified and comparable fossils on pp. 133-134 contain only a single ammonite (*Sarasinella campylotoxa*) which has also been recorded by Ackermann from the Bulgarian succession, so that there is no significance attached to the preponderance of French and Silesian names in our lists.

The open Mediterranean sea in the wider sense was probably the home of most if not all the ammonite stocks found in the lowest Cretaceous and thence they spread to Central America on the one hand and to the Himalayan province and the Indian Ocean on the other, ammonite spawn having apparently been dispersed by the currents with the greatest ease and rapidity. In spite of the arguments adduced by Schuchert[1] I do not consider it in the least "proved" that there was "a shore-line across the tropical Atlantic along which the benthonic ammonites dispersed," or that there was migration of ammonites "along the southern side of Gondwana." They must have spread while in the shell-less larval stage, and many of them were probably unwilling to leave their accustomed haunts in the adult, having changed to a more or less benthonic existence. Equally unfounded seems to me the theory of a "recurrence of the Uitenhage fauna in Bolivia, Chile and Argentina", since a very rich Mediterranean *Olcostephanus* assemblage existed so much nearer, in the Mexican area, and since no *Rogersites* has ever been found in South America. The assertion that "*Streblites* and *Aspidoceras* have spread from Europe to Mexico and in the reverse direction came *Idoceras and Proniceras*", has, if possible, still less justification, although I am not denying that such interchanges could have occurred. Both these genera have been known to be found in the Mediterranean area since Oppel's time, if under different names. The presence of *Idoceras* in Somaliland and Abyssinia[2], like the occurrence of *Proniceras* in the Tithonian of the Salt Range and its abundance at Chomérac (Ardèche), may have been unknown to Burckhardt from whom Schuchert obtained his information; to my mind, these examples again merely confirm the general similarity of the ammonite faunas of the "equatorial" zone "all over the world in strictly contemporaneous deposits, notwithstanding the admixture of local types."[3]

Folgner, in a MS. table of the fossils in the Wynne collection, marked the occurrence of comparable species in other well-known Neocomian localities, the columns being headed as follows and in this order:—Spiti, Madagascar, Uitenhage, Crimea, Patagonia, Mexico, Hils, Jura Mts., Speeton, Teschen and an illegible locality (yielding only a supposed *Leopoldia* sp. nov. aff. *leopoldi*, d'Orbigny sp.). Apart from a single doubtful *Lyticoceras* here described and in spite of Stolley's[4] suggestions concerning the source of "*Astieria*" and *Hibolites*, I can see little affinity between the Salt Range fauna and the assemblages of north-western Europe (Speeton and the German Hils deposits) and even this "*Lyticoceras*" could perhaps be matched by a Teschen species as easily as by forms of the *amblygonius*-

[1] Gondwana Land Bridges. *Bull. Geol. Soc. Am.*, Vol. XLIII, pp. 895-898 (1932).

[2] See Spath; Jurassic Ammonite Faunas of Mombasa. In *Monogr. Hunterian Mus., Univ. Glasgow.* Vol. IV, Pt. iii, p. 69 (1930); also Geology and Palaeontology of Somaliland, Pt. ii, No. 10, Jurassic and Cretaceous Cephalopoda, p. 212 (1935).

[3] Bajocian Ammonites and Belemnites from Eastern Persia (Iran). *Pal. Indica*, N. S., Vol. XXII, No. 3, p. 19 (1936).

[4] N. Jahrb. f. Min. &c., Beil. Bd. 73, B, pp. 390, 391 (1935).

noricus group. No new facts or monographs have been published on the Teschen and Swiss Jura Neocomian, however, since Uhlig wrote his summaries and it is only a few of the Mediterranean localities newly described or more completely studied since Uhlig's time that may be briefly considered.

In addition to the Bulgarian faunas (Ackermann, 1932, Cohen, 1933) already referred to, there are the account of the Neocomian cephalopoda of the Gerecse Mts. in Hungary by Koloman Somogyi v. Szilagysomlyo[1], descriptions of the Neocomian of Umbria by Lotti[2], and an account of the Cretaceous in north-eastern Italy, between the Adige and the Piave, with special reference to the Neocomian of the Sette Communi, by Rodighiero[3]. There is, also, a valuable record by Roch[4] of the Neocomian in western Morocco and an additional list can be given of the cephalopods of a famous exposure in the Tirol, namely Sebi near Kufstein. The latter record is based partly on a small suite in the collection of Dame Maria Ogilvie-Gordon, partly on a list of identifications made by Folgner in 1907 and incorporated in his manuscript notes. The Sebi fauna, correlated by Kilian[5] with the Berriasian (Infra-Valanginian), was known to have yielded *Spiticeras*; but the full list of cephalopods now given shows a surprising agreement with Uhlig's list of the cephalopods of the Upper Teschen Shales of the western Carpathians. A few forms from Folgner's list, such as *Barremites difficilis* (d'Orbigny), *B. psilotatus* (Uhlig), and *Hoplites* nova forma ex. aff. *H. narbonensis*, Pictet sp. (? *non Kilianiceras narbonense*)[6] I have omitted as, no doubt, due to misidentification. The generic nomenclature also has been revised:—

Phylloceras semistriatum (d'Orbigny).
Ptychophylloceras semisulcatum (d'Orbigny).
Phyllopachyceras infundibulum (d'Orbigny).
" *Phylloceras* " sp.
Lytoceras cf. *juilleti* (d'Orbigny).
Lytoceras sp.
Lytoceras (*Hemilytoceras*) cf. *liebigi* (Oppel).
Lytoceras (*Eulytoceras* ?) *subfimbriatum* (d'Orbigny).
Lytoceras (*Ammonoceras* ?) sp. (*densefimbriatum* group).
Protetragonites quadrisulcatus (d'Orbigny).
Leptotetragonites honnoratianus (d'Orbigny).
Neolissoceras grasianum (d'Orbigny).
Neolissoceras sp.
Neolissoceras ? sp. ind. (*Haploceras* cf. *leiosoma*, Zittel sp. in Folgner).
" *Oppelia* " *zonaria* (Zittel).
Spiticeras polytroptychum (Uhlig).
Spiticeras kiliani, Djanélidzé.

[1] *Mitteil. Jahrb. k. ungar. geol. Land. Anst.*, Vol. XXII, Heft 5 (1916).
[2] Descrizione geologica dell Umbria. *Mem. Carta geol. d'Italia*, Vol. XXI, Cap. IV, p. 75 (1926).
[3] *Pal. Italica*, Vol. XXV, [1919], pp. 39-125, Pls. VIII-XIII, 1922.
[4] Études géologiques dans la région méridionale du Maroc occidental (1930).
[5] *Lethaea mesozoica*, III, 1, fasc. 2, pp. 173, 191 (1910).
[6] Quoted also in Haug, Traité de Géologie, Vol. II, fasc. 2, p. 1203 (1907).

Spiticeras (*Negreliceras*) *negreli* (Matheron).
Spiticeras sp.
Berriasella sp. (*B. privasensis*, Pictet sp. in Folgner).
Berriasella sp. (*B. callisto*, d'Orbigny [Zittel] sp. in Folgner).
Subthurmannia boissieri (Pictet).
Subthurmannia occitanica (Pictet).
Neocomites neocomiensiformis (Hohenegger MS.) Uhlig sp.
Sarasinella cf. *ambigua* (Uhlig).
Kilianella pexiptycha (Uhlig).
Protacanthodiscus sp. (cf. *euthymi*, Pictet sp.).
Bochianites neocomiensis (d'Orbigny).
Aptychus imbricatus (Meyer).
Aptychus sp.
Duvalia lata (Blainville).
Duvalia dilatata (Blainville).
Pygope diphyoides (d'Orbigny) Pictet sp.

A similar but smaller assemblage from Wachtl near Kufstein includes later elements, like *Silesites* and *Hamulina*, and is not therefore here listed, but in both faunas the preponderance of French species is noticeable. The Mediterranean character of the assemblage listed also is beyond dispute. There is the typical abundance of *Phylloceras* and *Lytoceras*, and the scarcity of fossils other than ammonites, but the fauna might have come from anywhere else in the Alps, Carpathians, Appennines or northern Africa. Again Kilian[1] has shown that where there is an abundance of large Neocomitids (*Thurmannites*, etc.), the Phylloceratids and Lytoceratids are absent or at least rare. Uhlig[2] did not find a similar distribution of these families in the clay ironstone concretionary layers of the Upper Teschen Shales, but there are a number of assemblages known from the Alpine-Mediterranean Lower Neocomian in which *Phylloceras* and *Lytoceras* are not conspicuously abundant, for example, those of north-eastern Bulgaria[3] or of western Morocco[4]. Yet the former was described as a " rich, pelagic, cephalopod fauna, suggestive of a deep sea facies " ; in Morocco the facies of marly cephalopod limestones has yielded an abundance of Valanginian ammonites but mostly Neocomitids, *Olcostephanus* and belemnites, with only a few examples of *Lytoceras*.

In the Salt Range the deposits are sandy, glauconitic marls and they are transgressive, resting in at least one locality on Tithonian beds which are of as typically " Mediterranean " a facies as those of Cabra in Andalusia, of the Baleraic Islands or of Madagascar. Moreover, the Lower Cretaceous cephalopods here described, and generally condensed into a thin bed at the base of the succession, belong to a number of successive horizons. Bearing in mind the fact that

[1] See Kilian and Léenhardt : Sur le Néocomien des Environs de Moustiers-Ste.-Marie (Basses Alpes). *Bull. Soc. géol. France*, 3 sér., Vol. XXIII, p. 980 (1896) ; also Kilian : Notice stratigraphique surles Environs de Sisteron, etc., *ibid.*, p. 729 (1896).

[2] *Denkschr. k. Akad. Wiss. Wien*, Vol. LXXII, p. 76 (1902).

[3] Cohen (*Zeitschr. bulgar. geol. Ges.*, Vol. V, Heft 2), p. 169 (1933).

[4] Études géologiques dans le Maroc occidental, pp. 257 and 273 (1930).

strictly contemporaneous ammonite faunas are remarkably similar, in whatever province they might occur, we expect to find ammonites from the *schenki* zone resembling forms known from Speeton in Yorkshire and the Uitenhage beds of the Cape in South Africa. The Teschen fauna is different from that of Sayn's Valanginian marls because it is older; but in a condensed deposit the mixture of elements is not apparent. The forms of *Olcostephanus* described by Sayn from the Valanginian in the south of France again differ from those of Baumberger's *Astieria* marls because the latter are at a still higher level in the Valanginian succession. But it is only the recognition of what may seem to some to be minute subdivisions that has enabled us to find the real cause of the dissimilarity of so many ammonite faunas. Unfortunately the subdivisions of the lower Neocomian (as of the uppermost Tithonian) are not nearly as firmly established as those of other Jurassic and Cretaceous formations and thus the far less important differences of facies are still unduly stressed.

There must have been, in the Lower Cretaceous, as in the whole of the Jurassic, a broad "equatorial" zone, comprising all the so-called Mediterranean and Alpine areas of Europe and the extensions north and south, as well as the Himalayan, Ethiopean, Japanese, Maori and South Andine provinces of Uhlig[1]. Believing that the distribution of continents and oceans was already essentially the same as at the present day, except for the extended Tethys and areas of temporary transgressions, I visualise an "equatorial" zone reaching to about 45° latitude, north and south of the equator[2], but the distribution of ammonite faunas, of course, would have been governed by the warm, or less warm, currents of the period. Polyptychitids begin to be the dominant Valanginian ammonite family at Speeton in Yorkshire, and they abound especially in the North German Lower Neocomian, but they are not unknown from farther south and occur for example in the Jura Mts., in Mexico and in Colombia. It has been suggested that they were "boreal" elements, because in Spitsbergen Polyptychitids alone occur and there, as in East Greenland, Russia and in Lincolnshire, *Subcraspedites*, another so-called boreal element, characterises the Infra-Valanginian. But we are as yet very far from knowing the complete succession; and I have before me, for example, an East Greenland fauna of presumably earliest Cretaceous age that consists of entirely new and unnamed ammonites. There seems to be, in the circumstances, no affinity between the ammonites here described and those of the "boreal" (but ice-free) zone and its presumed cold-current[3] extensions, and there is no reason at all for assuming that elements from a supposed Antarctic counterpart of this "boreal" zone, almost a physical *sine qua non*, are represented in the Salt Range. But it is probable that these views of differing boreal and Mediterranean ammonite faunas will have to be fundamentally revised and that here again difference in date of the deposits will be found to account for the differences (apart from a general impoverish-

[1] See map (plate XIII) in Uhlig, *loc. cit. Mitteil. Geol. Ges. Wien*, Vol. IV (1911).

[2] A new name seems indicated for this zone.

[3] As previously pointed out (*loc. cit.*, Pal. Indica, N. S., Vol. 9, Mem. No. 2, pt. vi, p. 882), the climate in the ice-free Polar and Antarctic regions cannot have been nearly so cold as it is at the present day, so that there may be no need for Neumayr's intermediate "temperate" zones.

ment), rather than limited horizontal distribution of ammonites, undoubted though this may be for certain genera.[1]

(8) Central and South America.

The Lower Cretaceous deposits of South America must be discussed chiefly because they give a truer idea of the length of time represented by the Infra-Valanginian and Valanginian ages, and not because there is any close affinity between their ammonites (except, possibly, *Raimondiceras*) and those of the Salt Range. The Peruvian *Subthurmannia lorensis* (Lisson) to which one of the Indian forms has been compared, is too incompletely known to be of any significance; and since Burckhardt[2] has already shown that the majority of the Mexican Valanginian ammonites are related to species of the great "Mediterranean Province," the record of a form compared to the Mexican *Neocomites pronecostatus* (Felix) is of little import. But I have already mentioned that Folgner, in his MS. table of species in the Wynne collection, noted the occurrence of some of these in Patagonia (apart from two in Mexico); and a number of species especially of *Subthurmannia* were referred by him to South American forms of *Favrella*. This I believe to be due to misidentification. In the text Folgner described the genus *Favrella* as being confined to the Indo-Pacific region, as it had not been found in the well-explored Lower Cretaceous deposits of Europe; and he envisaged immigration from the east along the northern coast of an imaginary South Pacific continent, since representatives of the genus *Favrella* did not occur in the prolific Spiti Shales. Now in my opinion, the Salt Range species of *Subthurmannia* are far more closely related to *S. boissieri* (*sensu lato*) of Europe and the Spiti Shales than to *Favrella*, while one form (Plate XXI, fig. 2) is directly transitional to *Paraboliceras*, a genus that has not been found outside India. *Favrella*, in fact, like *Hatchericeras*, is a typically Patagonian genus, probably a local development of the widespread Berriasellidae; and it is very doubtful whether it spread as far as Chili or the Argentine Andes.[3]

On the other hand, *Substeueroceras koeneni* (Steuer) and its allies which are common in the Infra-Valanginian of the latter area (zones of *S. koeneni* and of *S. permulticostatum*, Steuer sp. in Gerth) also resemble *Subthurmannia*; and since *S.* aff. *boissieri* (Pictet) has been recorded by Krantz[4] from an equivalent of the *privasensis* zone (Upper Tithonian) of the Argentine, it could be held that these Berriasellids originated in the southern Andine region and thence migrated into the Mediterranean Province and its eastern extensions. But there must again be some misidentifications; for example, Krantz (p. 458) has a zone of *Parodon-*

[1] In a paper by Stolley (*Zentralbl. f. Min. etc.*, B, 1917), seen only during the correction of the proofs of the present work and therefore not fully utilised elsewhere in these pages, there appears a far more satisfactory succession of Valanginian ammonite faunas than was hitherto available, and he has traced for example the exact position of the horizon with *Valanginites* and "*Rotundites*" (a *nomen nudum*) within the Lower *Dichotomites* beds. It seems to me that if anywhere in the world, *e.g.*, in South America, an extended sequence of deposits, covering the whole of middle Valanginian time, be discovered, *Polyptychites* and *Platylenticeras* will be found, even if elements like *Phylloceras* and *Lytoceras* occur with them and transitions between the Berriasellids and the Neocomitids prove to be the dominant ammonites.

[2] Étude synthétique sur le Mésozoique mexicain. Mém. Soc. pal. Suisse, Vols. XLIX-L, p. 134 (1930).

[3] The supposed young of *Hoplites angulatiformis*, Behrendsen (*loc. cit.*, part II. *Zeitschr. Deutsch. Geol. Ges.*, Vol. 44, 1892, p. 16, pl. IV, fig. 2*a*) of *Deshayesites*-aspect, cannot belong to the same genus as the larger fragment (lectotype of the species) which itself is a very doubtful form of *Favrella*.

[4] *Steinmann Festschrift, Geol. Rundschau*, pp. 447, 458 (1926).

toceras calistoides (Behrendsen) three zones down in the Jurassic, while Gerth a few pages later (p. 483) lists this species (known also from the *boissieri* zone of the south of France) in the *permulticostatum* zone, four zones up in the Cretaceous. On the whole I agree with Gerth when he draws the line between the Cretaceous and the Jurassic at (or, preferably above) the limestone band with *Lytohoplites burckhardti* (Mayer-Eymar), where *Substeueroceras* first appears and *Aulacosphinctes* has died out. At San Pedro del Gallo in Mexico[1], however, corresponding *Substeueroceras* beds (with the succeeding Schistes du Pantéon, yielding *S.* cf. *koeneni*) are 350 feet in thickness and are succeeded by Infra-Valanginian *Spiticeras* and Valanginian *Olcostephanus* beds, to the extent of sometimes another 500 feet. Now an "*Astieria* cf. *sayni* (Kilian)" is recorded from the top of the *Olcostephanus* beds, or 850 feet above the base of the Cretaceous in Mexico; and if Krantz's identification is correct, and a *Subthurmannia* of the *boissieri* group has actually been found in the Tithonian of the Argentine, these two genera are separated by an enormous time interval. Yet they lie side by side in the basal beds of the Belemnite Shales in the Salt Range, and it could well be suggested, in view of the absence of *Spiticeras*, that only the Lower Infra-Valanginian was originally represented there. The destruction of its deposits at the oncoming of a later Valanginian transgression may have supplied the derived fragments of *Subthurmannia* that form the commonest and most characteristic element of the basal Belemnite Beds, but the table on p. 132, showing the representation of the Lower Cretaceous zones at the different localities, indicates how this denudation of pre-existing deposits and the condensation of their remains varied from place to place.

Since the *boissieri* zone alone (with a bathyal cephalopod facies) at Montclus, Hautes Alpes, is 333 feet in thickness, and in view of the extended succession in Bulgaria, already cited, the Mediterranean Province, in time, will be able to boast of a Lower Cretaceous succession not inferior to that of South America; but for various reasons, tectonic or lithological, collecting has proved less easy. Mexico, in the same equatorial zone as the Tethys, in any case, has most promising indications of a Cretaceous succession as complete as that of the Argentine, even if the great thicknesses noted by Weaver[2] are not attained; and since the majority of the Neocomian ammonites of Patagonia, like their Jurassic forerunners in South America generally, are immigrants from a more equatorial zone, it is not probable that there is any real affinity between the true *Favrella*, unknown even in Mexico, and their supposed Salt Range relations. The morphological resemblance, as has already been shown, in any case is only superficial; and it would have been inadvisable, in my opinion, to adopt for these forms Folgner's MS. name and to perpetuate a spurious affinity in the generic designation "*Patagonites*."

An important paper by R. W. Imlay,[3] seen only after the present work was already in proof, deals with a Valanginian fauna from Mexico, including

[1] See Burckhardt: *Bol. Inst. geol. Mexico*, No. 29, 1912, table to p. 228. In 1930 *Mém. Soc. pal. Suisse*, Vols. XLIX-L, table to p. 106) Burckhardt put these "*Steueroceras*" beds into the Jurassic ("Upper Portlandian").

[2] *Mem. Univ. Washington*, Vol. I, pp. 54 etc. (1931).

[3] Lower Neocomian Fossils from the Miquihuana Region, Mexico. Journ. Palaeont, vol. xi, No. 7, pp. 552-574, pls. lxx-lxxxiii (1937).

eighteen species of ammonites that deserve brief notice. Forms of *Olcostephanus* and *Rogersites* are dominant, and while two species (*Rogersites paucicostatus* and *R. tenuicostatus*, Imlay) are different from any here described, the remaining six seem to be closely allied to, if not identical with, Salt Range forms. These species include *O. filifer* (Imlay) which is much like *O. victoris*, figured in Plate XIX, fig. 7, but which has a higher umbilical slope; *O. sanlazarensis* (Imlay) which is possibly identical with *O. fascigerus*; *O. bakeri* (Imlay) which also resembles that Indian species but which has a narrower umbilicus than the example figured in Plate IV, fig. 1; finally *O. prorsiradiatus* (Imlay) which looks like the specimen of *O. sublaevis*, represented in Plate XIX, fig. 2 and which has a smaller umbilicus than *O. glaucus* (Plate VI, fig. 7). Two more forms are merely listed.

The five species of *Thurmannites* which come next in importance, include four large forms which are not comparable to Salt Range species merely because the latter are mostly small. Similarly large Hoplitids in the present collection are from the lower (*Subthurmannia*) beds and of a different type. The smaller *Thurmannites novihispanicus*, Imlay, however, is comparable to Indian species although it represents a late type and could even be the adult of a form of *Sarasinella* like that figured in Plate XVI, fig. 2, the inner whorls being missing.

Four elements of the Mexican fauna (a *Bochianites* ? sp., a *Distoloceras* and two species of *Valanginites*) seem to be typical Upper Valanginian forms, but they are different from any Indian species, as is the single fragment of a very doubtful *Favrella* which genus may still be considered to occur only in Patagonia. Altogether it appears that what difference there is between the faunas of Mexico and the Salt Range is largely due to differences in age of the deposits, those of the latter area being largely Lower Valanginian, the former entirely Upper Valanginian.

(9) California.

The presence of Infra-Valanginian as well as of Lower, Middle and Upper Valanginian deposits in the Shasta Series (Paskenta Beds) has recently been announced by Anderson[1], and he recorded ammonoids from each of these divisions, but with the exception, perhaps, of one listed as *Astieria* cf. *astieri* (d'Orbigny) they have no close affinity with the forms here described from the Salt Range. The interest of this form of "*Astieria*" lies in its being associated with *Substeueroceras* cf. *intercostatum* (Steuer) and another species, said to resemble *S. permulticostatum* (Steuer), *i.e.*, forms that recall certain species of *Subthurmannia*, but that, in the Argentine, occur below the beds with *Spiticeras damesi* and which thus, must be still Infra-Valanginian. If the identification of the "*Astieria*" is correct it would be the earliest form of *Olcostephanus*.

Not only is there an abundance of *Buchia* ("*Aucella*"), almost throughout the Paskenta succession, but, in addition to immigrants from the north, *e.g.*, such boreal genera as *Polyptychites*, *Simbirskites* etc., there are the elements of

[1] Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. *Report* XXVIII, *State Mineralogist* (1932) 1933 p. 322; also Knoxville-Shasta Succession in California. *Bull. Geol. Soc. Am.*, vol. 44, p. 1258 (1933).

Argentinian affinities that must have come from the south, if not from the Andean region, at least from Mexico or the equatorial zone. These are examples of faunal distribution by currents at right angles to the climatic zones. But in a recent Abstract of his paper on the "Lower Cretaceous Deposits in California and Oregon" Anderson announces that the invertebrate faunas to be described are largely Indo-Pacific in character and that their nearest allies, in part, have been found in south-west Asia (Caucasus, Cutch, Australia). It is probable that these species are all Aptian; for the Shasta Series (with a maximum thickness of as much as 27,000 feet) is claimed to extend from the Infra-Valanginian to the Middle Albian. That is to say, when the 150 cephalopods, many of them new, are described the reputed Indian elements may not be so conspicuous in the Lower Neocomian part of the series as appears; but there can be no doubt that the publication of these faunas will be awaited with the greatest interest.

(10) The Malay Archipelago.

The extremely close affinity between the Upper Jurassic ammonites of the Himalayan area and its extension to the east, to Malaya, and even to New Zealand, has long been recognised; but when Uhlig wrote, very little was known concerning the Lower Neocomian, even of Sumatra. The ammonite fauna from the latter island, since described by Baumberger, was, in the first place, compared to that of Sayn's Valanginian Marls of south-eastern France. But it consists only of *Olcostephanus* and Neocomitids, the latter in large numbers of individuals; there are no examples of *Phylloceras* or *Lytoceras*. Tracing comparable ammonite faunas through the European zone of Alpine folding, as far as the Crimea and to the east, Baumberger noticed the Valanginian forms in what he called the shallow-water deposits of the Salt Range, and he described his Sumatran fauna as marking the most easterly outpost in that chain of Mediterranean Valanginian occurrences, mostly in the facies of the marginal, neritic deposits of the geosynclines. There is no doubt that such forms as *Astieria* sp., *Neocomites platycostatus*, Sayn, *N. teschenensis* (Uhlig), *Thurmannites pertransiens* (Sayn) are very closely related to forms here described from the Salt Range; but unfortunately our knowledge of the marine Lower Neocomian does not extend beyond Sumatra. A very useful survey of the Mesozoic deposits of the Dutch East Indies was published in 1931 by Wanner[1] and as regards the Lower Neocomian the successions show deplorable gaps; there are doubtful *Duvalia* from Timor, *Hibolites subfusiformis* from Misol, and perhaps contemporaneous deposits on Seran, but the *Blanfordiceras wallichi* of the Sula Islands and New Guinea are probably of Tithonian age, like the other Spiti Shales elements with which they occur. Since another "*Blanfordiceras*," recorded by Grabau from Hong Kong has now turned out to have been based on a Lower Liassic Schlotheimid, no record of marine Lower Cretaceous or passage beds into the Tithonian in Eastern Asia remains and the "Hong Kong Bay" of Grabau's [2] map is no longer needed.

[1] Mesozoikum. Feestbundel K. Martin, pt. V, No. 19. *Leidsche Geol. Meded.* pp. 597-603 (1931).
[2] Stratigraphy of China, pt. ii, Mesozoic. Geol. Survey of China, p. 456, fig. 581 (1928).

The Pacific, like the Atlantic, must have been much as it is at the present day or as it was during the Jurassic, except that the comparatively small areas of temporary transgressions continually changed. Unfortunately the marine or other Lower Cretaceous deposits of the western part of the region are so scant or so little explored that I can add nothing to what I[1] wrote in connexion with the Jurassic ammonite faunas. It is clear, however, that there was no uniform "Pacific" fauna, that the ammonite assemblages are largely composed of the same elements as those of "Atlantic" countries, with far greater variety and abundance in the "equatorial" zone than near the poles, but that only assemblages of the very smallest subzones are really comparable. Conditions of dispersal are different at the present day; the severe climatic conditions no longer allow of such free interchange of faunas as occurred during the Mesozoic, and the recognition of separate faunal provinces is a much simpler problem for the biologist than it is for the student of ammonites.

[1] Spath (*Pal. Indica*, N. S., Vol. IX, Mem. No. 2, Pt. 6), pp. 825-826 (1933).

VI.—SUMMARY.

The Cephalopoda of the Salt Range, generally found condensed into the basal beds of the glauconitic, sandy, Belemnite Marls, have been shown to belong to various horizons. There are some (outside the scope of the present paper) undoubtedly derived from the denudation of equivalents of the Jurassic Chidamu Stage of the Spiti Shales, in an identical facies but not now exposed. There are also a few small forms that could have come out of an Upper Tithonian (*i.e.*, Lower Berriasian) conglomeratic, limestone which, in one locality, seems to underlie the Belemnite Beds; but the similarity of some of these ammonites to undoubted Cretaceous (*i.e.*, Upper Berriasian) forms has suggested their description with the Neocomian fauna here dealt with. The great majority of the 84 species, however, are of undoubted Infra-Valanginian (*i.e.*, Upper Berriasian) and Valanginian age and there is no sign of anything suggestive of the Hauterivian. Even so, the Lower Neocomian ammonites are referable to at least six zones, unequally represented at the different localities. Those from the lower zones are probably always derived, or at least semi-derived.

The 84 cephalopods include 81 ammonites and three belemnites; the former are mostly members of the three families Olcostephanidae, Berriasellidae and Neocomitidae and there is only a single Lytoceratid and one species of a Haploceratid. Their affinities are naturally with the rich and varied ammonite faunas of the great equatorial belt (Tethys and extensions) and there is no evidence in favour of immigration of any element from the impoverished "boreal" province. The Madagascan Lower Neocomian assemblages have proved of special interest for comparison, but a review of other contemporaneous faunas from nearly all over the world is attempted to supplement the summary published by Uhlig in 1911.

There are considerable differences in facies and otherwise between the various assemblages, especially those from the Salt Range proper, as compared with those of the Trans-Indus extension. The ammonites have therefore been analysed with special reference to their chronological significance, but the comparatively unimportant if ubiquitous belemnites belong almost entirely to a single species-group. The range of the dominant ammonite genus (*Olcostephanus*) represented by 200 examples, and of its fore-runners, is discussed, also the distribution of the various other ammonites within the six zones of the Lower Neocomian (Infra-Valanginian and Valanginian). The importance of the problem of condensation is also stressed. The chapter headed palaeontological conclusions comprises a brief review of the elements other than cephalopoda that are represented in the Belemnite Beds. The final chapters also include discussions on the migration and dispersal of ammonites, the recognition of provinces and climatic zones, and related problems, and it is hoped that they may be of general interest.

ALPHABETICAL INDEX TO SPECIES.

MGIPC—M—VIII-4-3—16-1-39—375.

PLATE I.

FIGS. 1*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov. Holotype, G. S. I. Type No. 16555. (loc. 687). (Page 13).

FIG. 2. OLCOSTEPHANUS SALINARIUS, sp. nov., var. INVOLUTA, nov. Typical example of the variety (loc. 687). G. S. I. Type No. 16556. (Page 13).

FIGS. 3*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov., var. CRASSA, nov. Typical example of the variety (loc. 687). G. S. I. Type No. 16557. (Page 13).

FIGS. 4*a-d*. NEOLISSOCERAS GRASIANUM (d'Orbigny). Two specimens, natural size and enlarged × 2. (loc. 687). Nos. K. 33/687*a'*, *a''* (Page 8).

FIGS. 5*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov. (var. ?). Inner whorls of one of the more inflated varieties (loc. 687). G. S. I. Type No. 16560. (Page 13).

FIGS. 6*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov., var. SUBFILOSA, nov. Typical example of this variety (loc. 685). G. S. I. Type No. 16558. (Page 13).

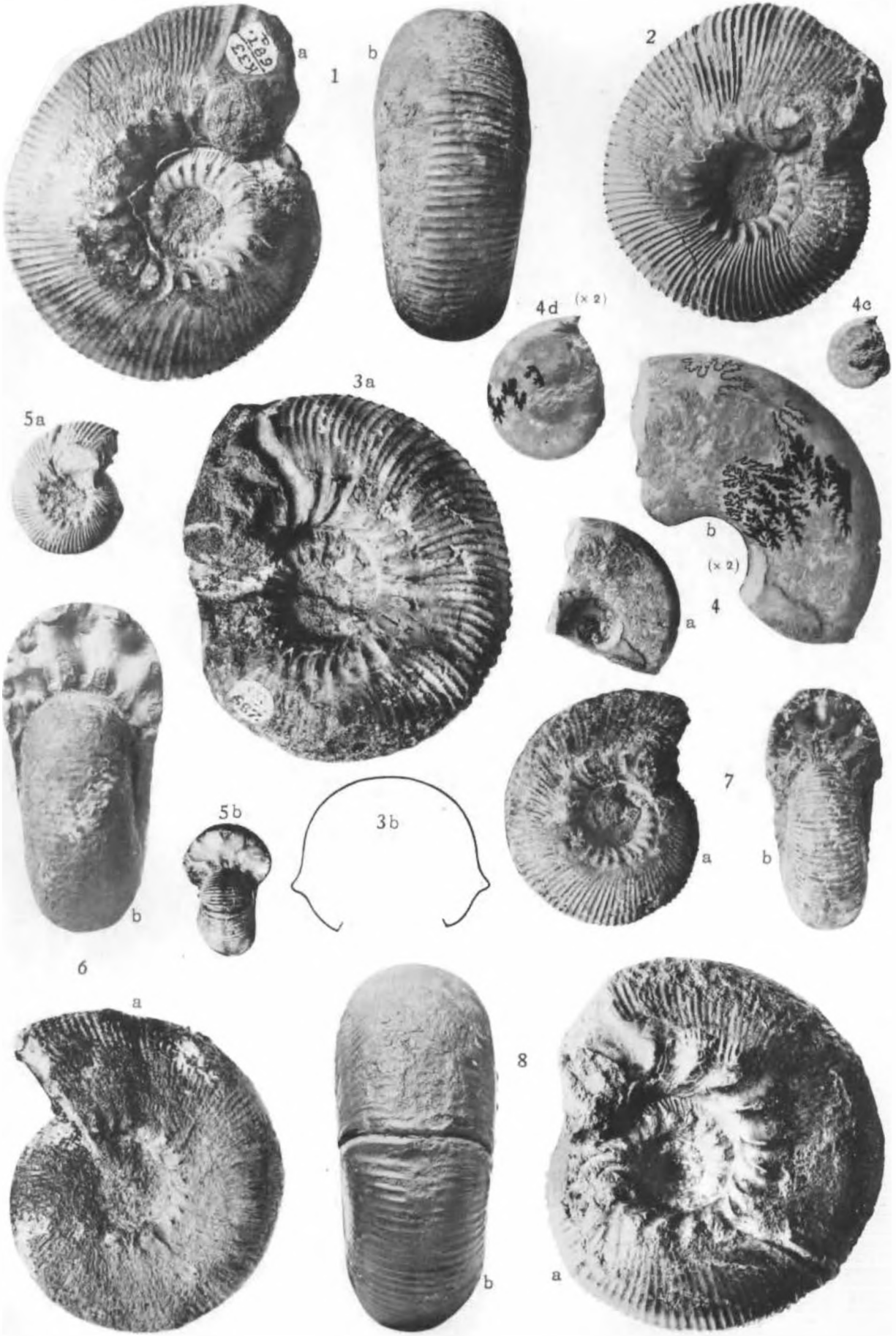
FIGS. 7*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov. Inner whorls of a typical example (loc. 687). G. S. I. Type No. 16561. (Page 13).

FIGS. 8*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov. Paratype. Chichali Hills. (B. M. No. C. 93*b*). (Page 13).

All the specimens figured in this plate are from the Belemnite Beds (Neocomian) of the Trans-Indus Range (Chichali Hills).

Geol. Surv. of India

Plate I.



E. J. Manly, photo.

Zinco Collotype Co., Edinburgh

PLATE II.

FIGS. 1*a,b*. OLCOSTEPHANUS RADIATUS, sp. nov. Part of holotype, with outer half-whorl omitted (loc. 685). G. S. I. Type No. 16580. (Page 27).

FIGS. 2*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov., var. OBESA. Small example of this variety (loc. 682). G. S. I. Type No. 16562. (Page 13).

FIGS. 3*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov. Slightly worn example, transitional between the type and the var. OBESA. Kalabagh. B. M. No. C. 35203 (Fleming Coll.). (Page 13).

FIG. 4. OLCOSTEPHANUS SALINARIUS, sp. nov., ? aff. var INVOLUTA, nov. (transition to O. VICTORIS). Largest example. Chichali Nala, north limb (Morris Coll., B. M. No. C. 39667). (Page 13).

FIGS. 5*a,b*. OLCOSTEPHANUS SALINARIUS, sp. nov., var. OBESA, nov. Typical example of this variety (loc. 687). G. S. I. Type No. 16559. (Page 13).

FIGS. 6*a,b*. OLCOSTEPHANUS (ROGERSITES) SCHENKI (Oppel). Fragment with outline whorl-section (loc. 687). No. K. 33/687*c* (Page 30).

FIGS. 7*a-d*. Gen. nov. ("AULACOSPHINCTES" ?) sp. ind. nov. Septate fragment, natural size (*a-c*), and enlarged × 2. (*d*). (loc. 680). No. K. 33/680*c* (Page 40).

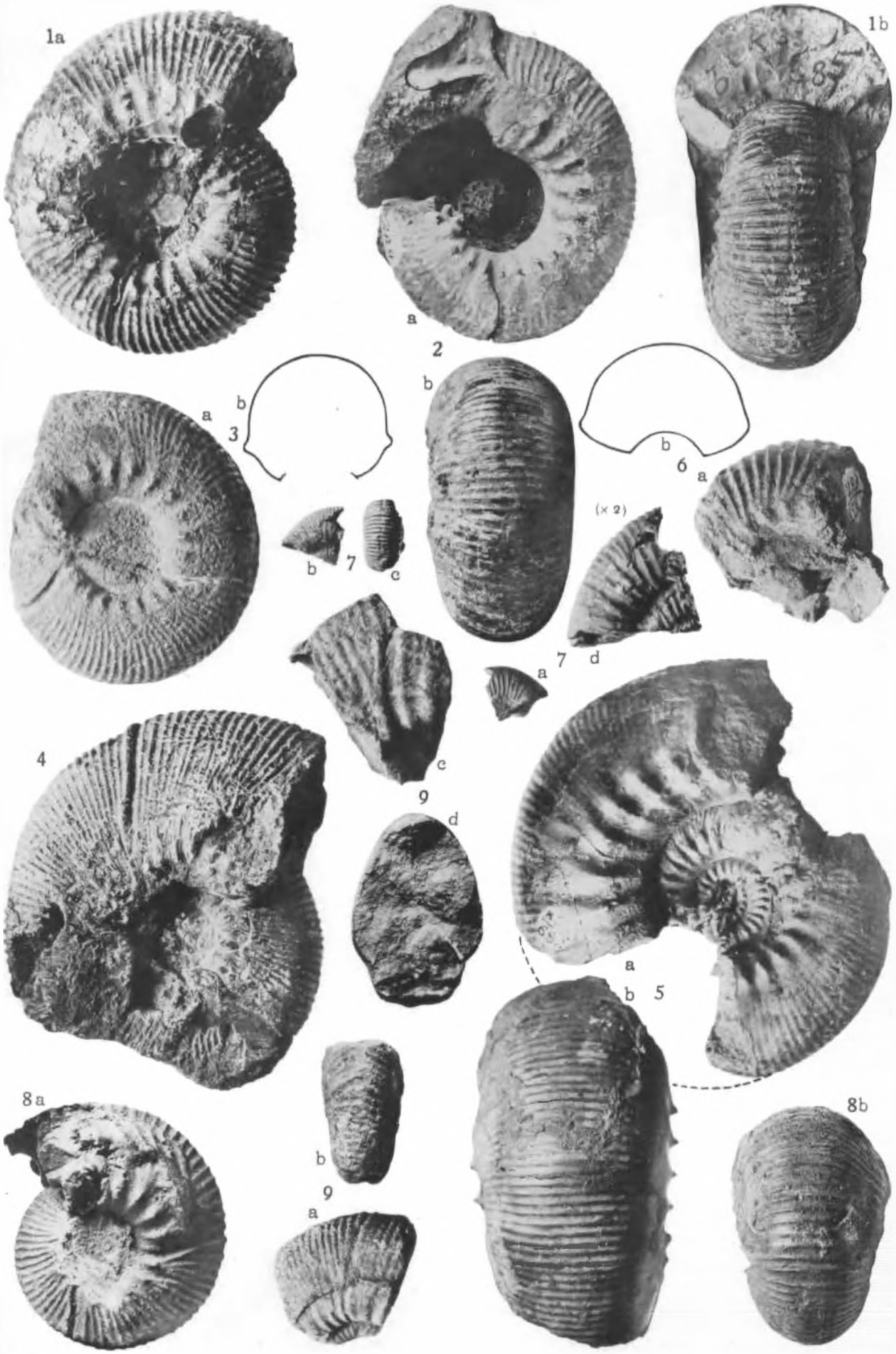
FIGS. 8*a,b*. OLCOSTEPHANUS (ROGERSITES) aff. SCHENKI (Oppel). Malformed young transitional example from N. W. of Ambiky, Madagascar (B. M. No. C. 38024, H. Besairie Coll.) (Page 31).

FIGS. 9*a-d*. SPITICERAS (NEGRELICERAS) sp. nov. aff. SUBNEGRELI, Djanélidzé. Two septate fragments (loc. 682). No. K. 33/682*a'*, *a''* (Page 38).

All the specimens figured in this plate, except fig. 8, are from the Belemnite Beds of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate II.



E. J. Manly, photo.

Zinco-Collotype Co., Edinburgh

PLATE III.

FIG. 1. OLCOSTEPHANUS SUBLAEVIS, sp. nov. Holotype, G. S. I. Type No. 16571. (loc. 687). (Page 21).

FIGS. 2*a*,*b*. OLCOSTEPHANUS SUBLAEVIS, sp. nov. Paratype, G. S. I. Type No. 16572. (loc. 687). (2*a* slightly tilted).

FIGS. 3*a*,*b*. OLCOSTEPHANUS SUBLAEVIS, sp. nov. Inner whorls, with outline whorl-section. G. S. I. Type No. 16573. (loc. 673) (Page 21).

FIGS. 4*a*-*d*. PRONICERAS INDICUM, sp. nov. Holotype, G. S. I. Type No. 16582, natural size (*a*,*b*), and enlarged × 2 (*c*,*d*). (loc. 680). (Page 34).

FIG. 5. OLCOSTEPHANUS sp. ind. Peripheral view of body-chamber (loc. 685). No. K. 33/685*a* (Page 24).

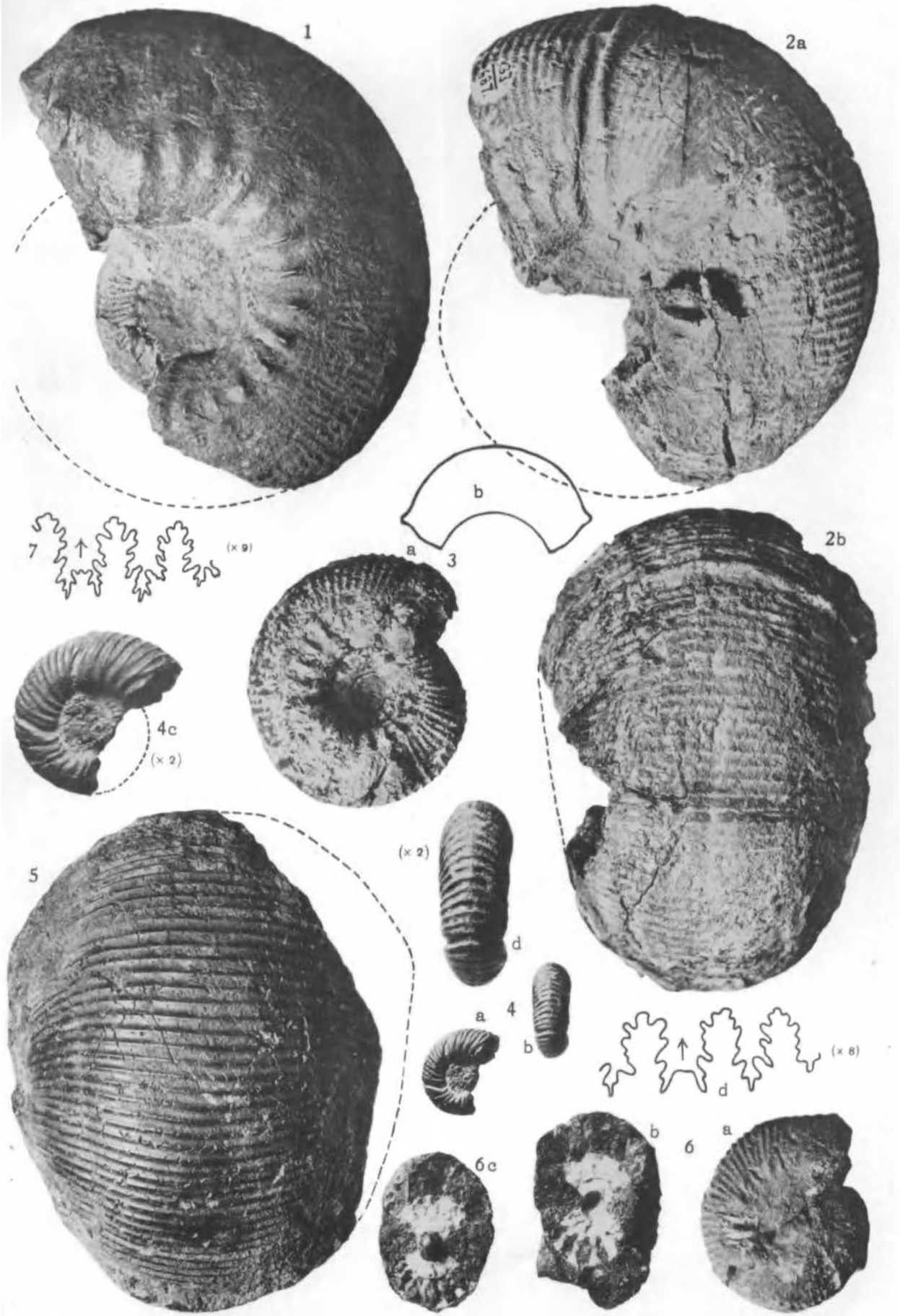
FIGS. 6*a*-*d*. OLCOSTEPHANUS SUBLAEVIS, sp. nov., transitional to O. (ROGERSITES) SCHENKI (Oppel). The suture-line *d* (enlarged × 8) was taken from the innermost whorls shown in the fractured half *c*, *b* being the counterpart (loc. 687). G. S. I. Type No. 16574. (Page 21).

FIG. 7. OLCOSTEPHANUS aff. ASTIERIANUS (d'Orbigny) auct. Part of external suture-line (enlarged × 9) of a small, limonitised example from Barrème, Basses-Alpes (B. M. No. 73471*d*, Astier Coll.) for comparison with fig. 6*d*. (Page 22).

All the specimens figured in this plate, except fig. 7, are from the Belemnite Beds of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate III.



E. J. Manly, photo.

Zinco-Collotype Co. Edinburgh

PLATE IV.

FIG. 1. OLCOSTEPHANUS FASCIGERUS, sp. nov. Holotype, G. S. I. Type, No. 16568. (loc. 687A). (Page 18).

FIGS. 2*a*,*b*. OLCOSTEPHANUS FASCIGERUS, sp. nov. Paratype. Makerwal Colliery. Pinfold Coll. B. M. No. C. 39683.

FIGS. 3*a*,*b*. OLCOSTEPHANUS FASCIGERUS, sp. nov. Third example. Chichali Nala, north limb. Morris Coll. B. M. No. C. 39668.

FIGS. 4*a*,*b*. SPITICERAS (NEGRELICERAS ?) sp. ind. Two peripheral views. (loc. 682). No. K. 33/682*b*. (Page 39).

FIGS. 5*a*,*b*. BLANFORDICERAS cf. BOEHMI (Uhlig). Peripheral view not central. For suture-line see Plate V, fig. 2. No. K. 33/682*c'*. (loc. 682). (Page 45).

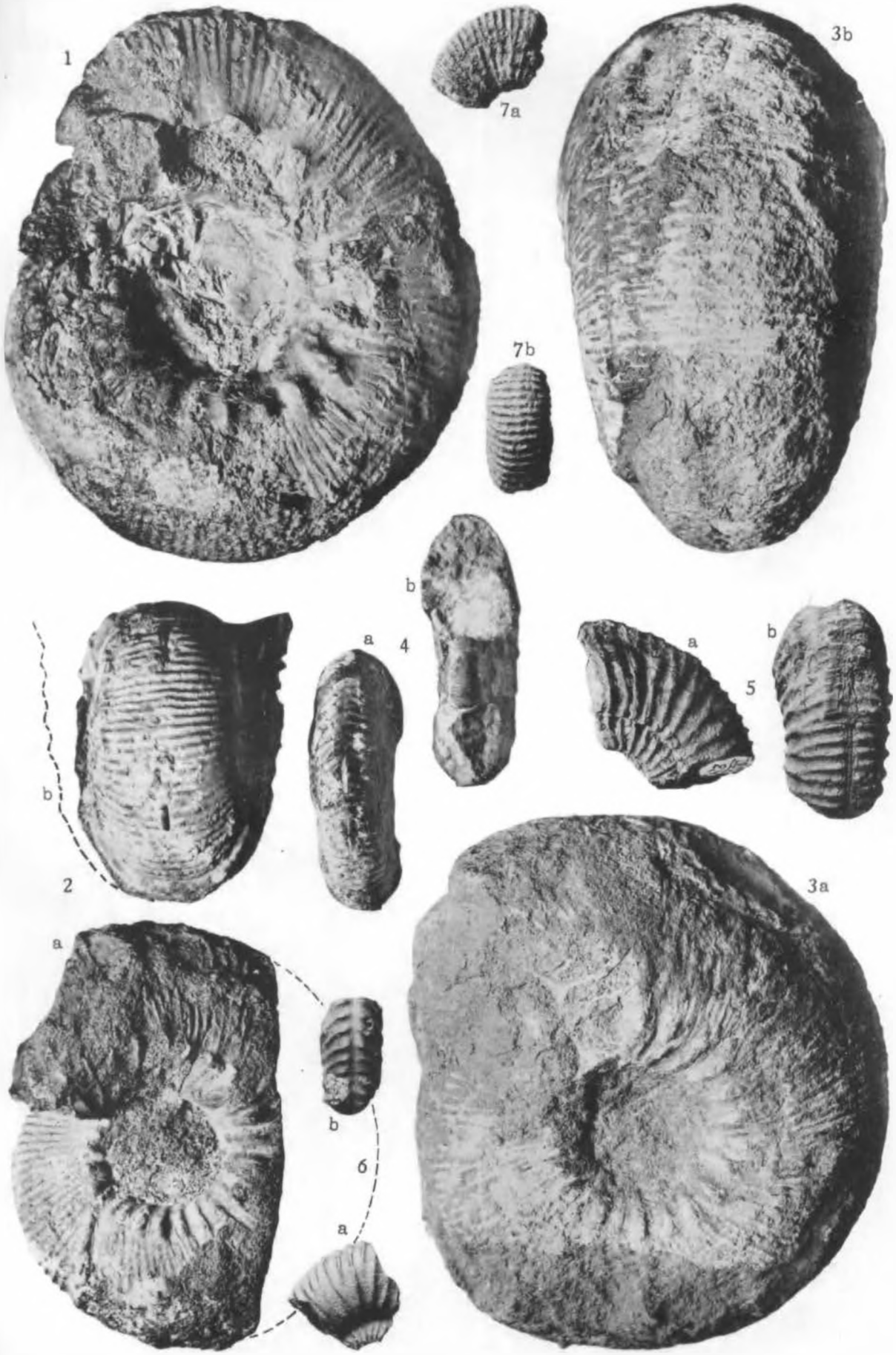
FIGS. 6*a*,*b*. BLANFORDICERAS aff. WALLICHI (Gray). Septate fragment (loc. 680). Ex Tithonian (?). No. K. 33/680*d'*. (Page 43).

FIGS. 7*a*,*b*. BLANFORDICERAS (BERRIASELLA ?) sp. ind. Doubtful example (loc. 699). No. K. 33/699*a*. (Page 118).

All the specimens figured in this plate are from the Belemnite Marls of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate IV.



E. d. Manly, photo.

Zinco-Collotype Co. Edinburgh

PLATE V.

FIGS. 1*a*,*b*. BLANFORDICERAS aff. WALLICHI (Gray). Septate fragment (loc. 687). No. K. 33/687*d*′. (Page 43).

FIG. 2. BLANFORDICERAS cf. BOEHMI (Uhlig). External suture-line of the fragment figured in Plate IV, fig. 5 (loc. 682). No. K. 33/682*c*. (Page 45).

FIGS. 3*a*,*b*. OLCOSTEPHANUS GLOBOSUS, sp. nov. Holotype, G. S. I. Type, No. 16565. (loc. 687). (Page 16).

FIGS. 4*a*,*b*. OLCOSTEPHANUS, sp. juv. (group of O. COLLIGNONI, Besairie sp.). ROGERSITES beds, N. W. of Ambiky, Madagascar (B. M. No. C. 38021). (Page 138).

FIG. 5. OLCOSTEPHANUS SAKALAVENSIS (Besairie). An almost untuberculate form (for comparison with O. SALINARIUS, sp. nov., var. SUBFILOSA, nov.) from the same locality and collection (No. C. 38022). (Page 138).

FIG. 6. BLANFORDICERAS aff. WALLICHI (Gray). External suture-line, enlarged × 4, of a small doubtful fragment (loc. 680). No. K. 33/680*d*″. (Page 43).

FIG. 7. HIMALAYITES (?) sp. ind. Doubtful inner whorls of a large ammonite (loc. 682). No. K. 33/682*e*. (Page 65).

FIG. 8. HIMALAYITES cf. SEIDELI (Oppel). Internal cast (loc. 687). No. K. 33/687*j*. (Page 64).

FIGS. 9, 10. BLANFORDICERAS aff. WALLICHI (Gray). Doubtful fragment, No. K. 33/680*d*′,*d*″ and inner whorls No. K. 33/680*d*‴ (loc. 680). (Page 43).

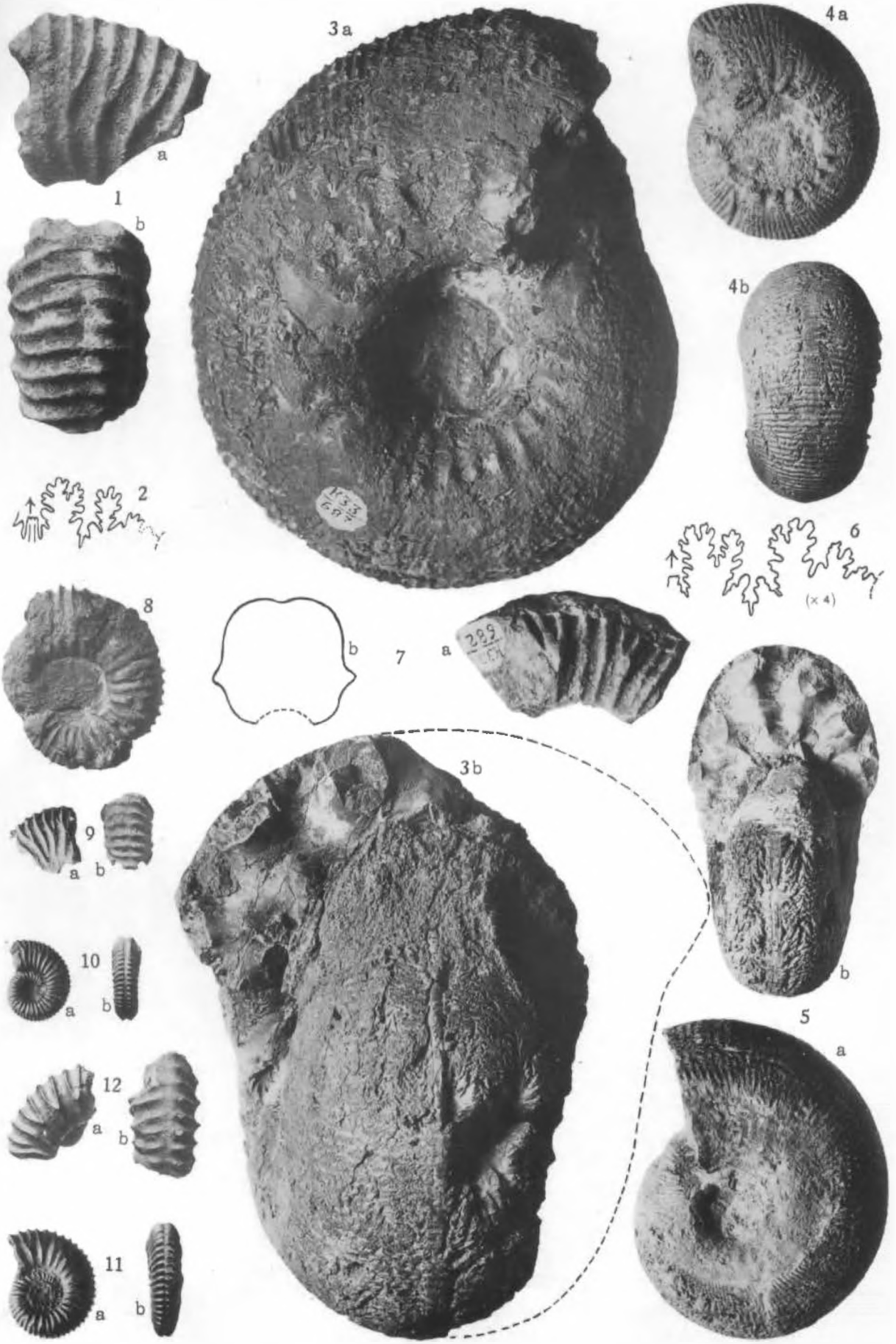
FIGS. 11*a*,*b*. BLANFORDICERAS, sp. nov. ? Septate example (loc. 680). No. K. 33/680*e*. (Page 44).

FIGS. 12*a*,*b*. BLANFORDICERAS aff. LATIDOMUS (Uhlig). Doubtful fragment (loc. 680). No. K. 33/680*h*. (Page 46).

All the specimens figured in this plate, except figs. 4 & 5, are from the Belemnite Beds of the Salt Range and the Trans-Indus Range.

Geol. Surv. of India

Plate V.



E. J. Manly, photo.

Zinco-Collotype Co., Edinburgh

PLATE VI.

FIGS. 1*a,b*. PROTACANTHODISCUS ? sp. ind. Septate example, with beginning of body-chamber (loc. 687). No. K. 33/687*k*. (Page 67).

FIGS. 2*a,b*. BLANFORDICERAS aff. WALLICHI (Gray). Doubtful example (loc. 687). No. K. 33/687*d''*. (Page 43).

FIGS. 3*a-d*. PROTACANTHODISCUS ? sp. ind. Fragment in natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680*j*. (Page 67).

FIGS. 4*a-d*. NEOCOSMOCERAS sp. nov. Typical example in natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680*k'*. (Page 68).

FIGS. 5*a-c*. BLANFORDICERAS sp. juv. cf. BOEHMI (Uhlig). Inner whorls (loc. 680). No. K. 33/680*g'*, *g''*. (Page 45).

FIG. 6. OLCOSTEPHANUS cf. PERINFLATUS (Matheron). Sectional outline (loc. 685). No. K. 33/685*b*. (Page 25).

FIGS. 7*a,b*; 8. OLCOSTEPHANUS GLAUCUS, sp. nov. Paratype G. S. I. Type, No. 16567 (7), and holotype G. S. I. Type, No. 16566 (8). (locs. 685 and 687). (Page 17).

FIG. 9. BLANFORDICERAS (Gen. nov. ?) sp. nov. Small fragment of the form figured in Plate XVIII, fig. 7 (loc. 680). No. K. 33/680*i*. (Page 47).

FIG. 10. BLANFORDICERAS cf. ACUTICOSTA (Uhlig). Fragment in natural size. (loc. 680). No. K. 33/680*f'*. (Page 45).

FIGS. 11, 12. BLANFORDICERAS cf. BOEHMI (Uhlig). Two limonitic fragments, 11 *a*, *b* being transitional to B. ACUTICOSTA (Uhlig). No. K. 33/680*g'''*, *g''''*. (Page 45).

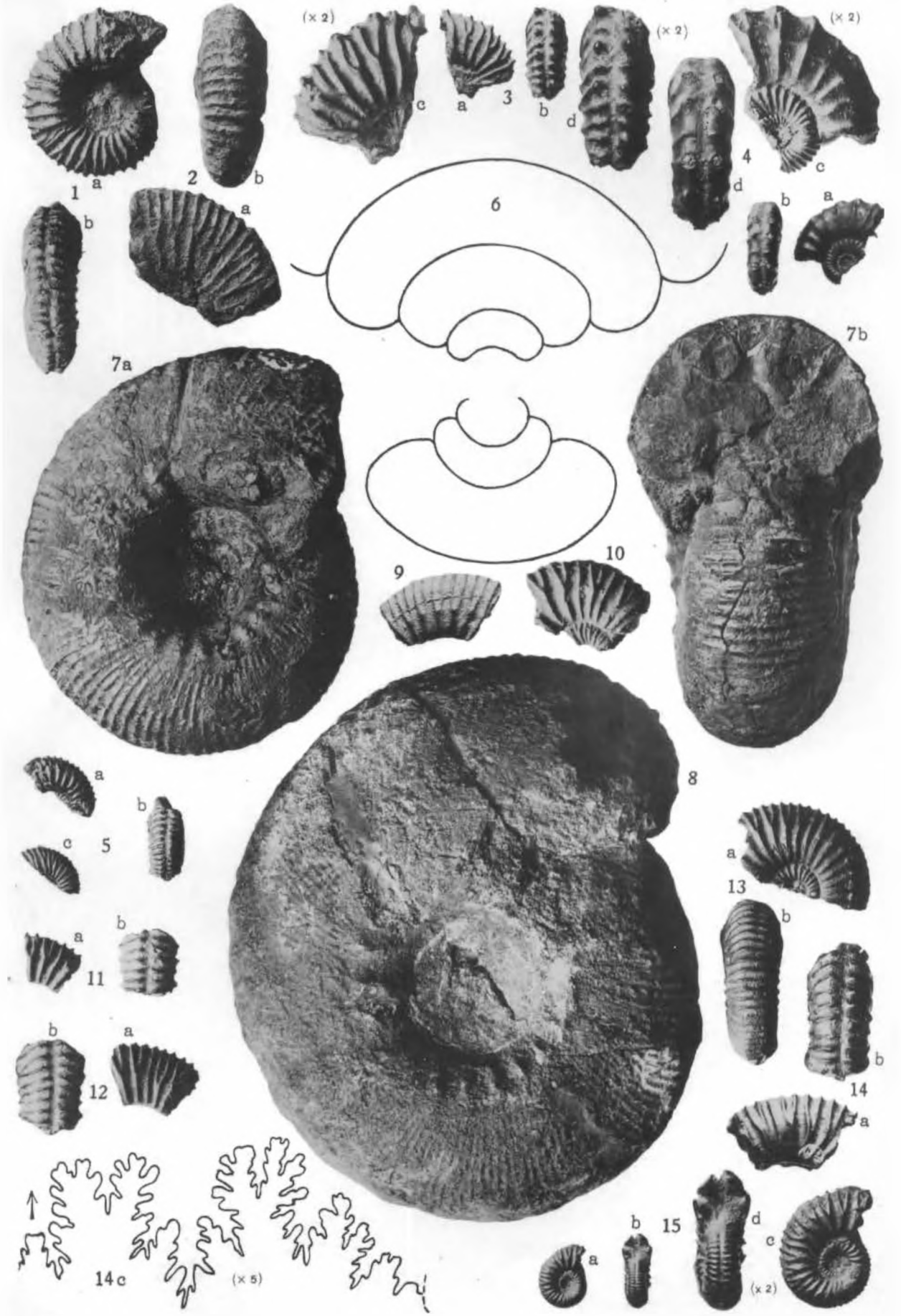
FIGS. 13, 14. BLANFORDICERAS cf. ACUTICOSTA (Uhlig). Two examples, one (13) malformed, the other (14) with external suture-line, enlarged × 5 (loc. 680). No. K. 33/680*f''*, *f'''*. (Page 45).

FIGS. 15*a-d*. BLANFORDICERAS cf. BOEHMI (Uhlig). Malformed example, natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680g^5. (Page 45).

All the specimens figured in this plate are from the Belemnite Beds of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate VI.



E. J. Manly, photo.

Zinco-Collotype Co., Edinburgh

PLATE VII.

FIGS. 1*a-c.* HIMALAYITES ? (Gen. nov. ?) sp. ind. Two sides and peripheral aspect of a malformed example (loc. 682). No. K. 33/682*f*. (Page 66).

FIGS. 2*a-d.* Gen. nov. (NEOCOSMOCERAS ?) sp. ind. Example in natural size (*a,b*), and enlarged × 2 (*c, d*). (loc. 680). No. K. 33/680*m*. (Page 73).

FIGS. 3*a-d.* NEOCOSMOCERAS sp. ind. cf. SAYNI (Simionescu). Fragment in natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680*l*. (Page 70).

FIGS. 4*a-d.* NEOCOSMOCERAS sp. nov. More complete example than that figured in Plate VI, fig. 4. (loc. 680). No. K. 33/680*k''*. (Page 68).

FIGS. 5*a,b.* OLCOSTEPHANUS GEEI, sp. nov. Holotype, G. S. I. Type, No. 16578. (loc. 687). (Page 26).

FIGS. 6*a-c.* OLCOSTEPHANUS GEEI, sp. nov. Paratype, G. S. I. Type, No. 16579, with smooth inner whorls, natural size (*b*), and enlarged × 2 (*c*). (loc. 687). (Page 26).

FIGS. 7*a,b.* OLCOSTEPHANUS sp. ind. cf. DRUMENSIS (Sayn MS.) Kilian. Septate fragment (loc. 687). No. K. 33/687*b*. (Page 15).

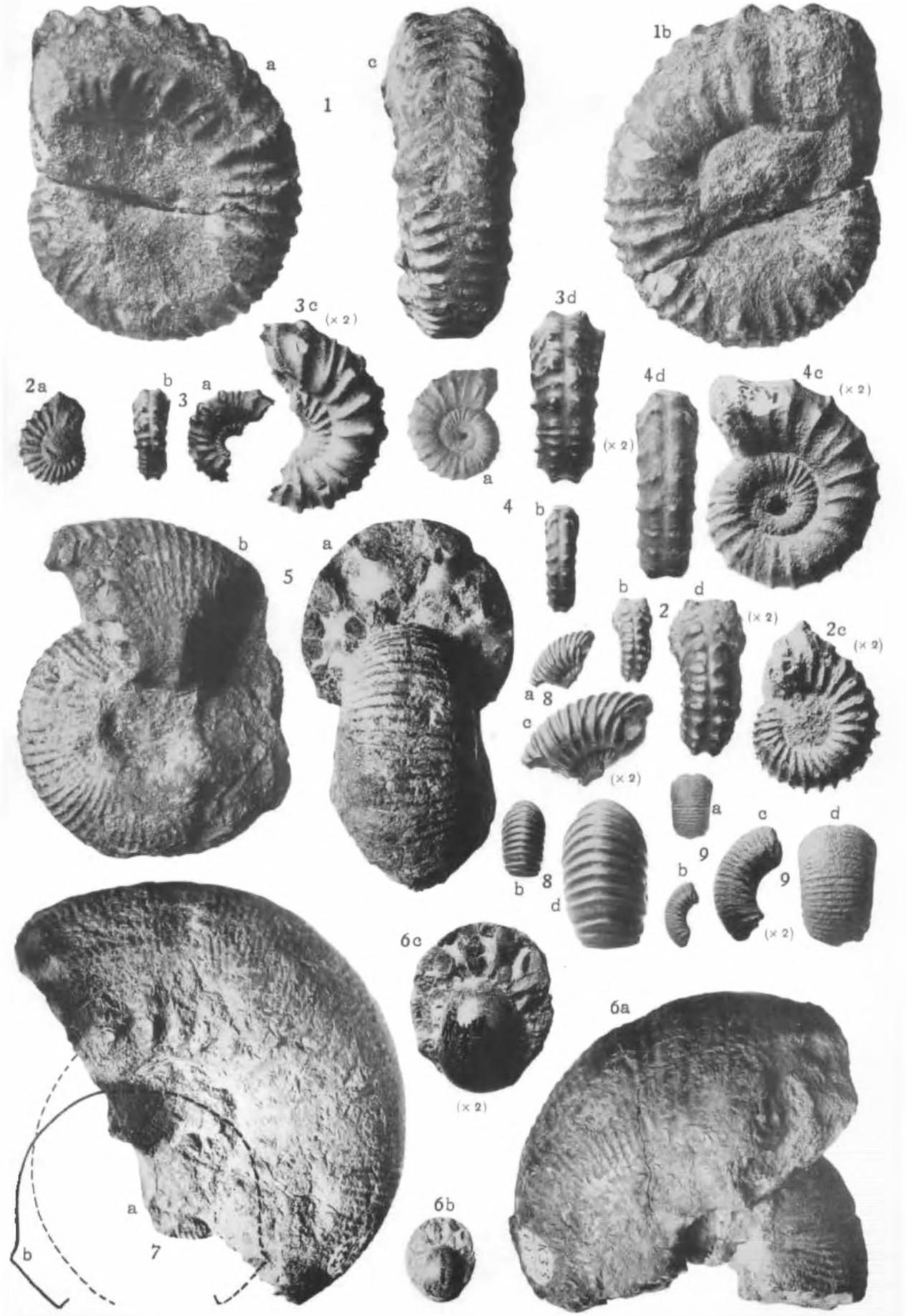
FIGS. 8*a-d.* PRONICERAS sp. ind. Septate fragment, natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680*a*. (Page 36).

FIGS. 9*a-d.* SPITICERAS (?) sp. ind. juv. Septate fragment, natural size (*a,b*), and enlarged × 2 (*c,d*). (loc. 680). No. K. 33/680*b*. (Page 36).

All the specimens figured in this plate are from the Belemnite Beds of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate VII.



E. J. Manly, photo.

Zinco-Collotype Co., Edinburgh

PLATE VIII.

FIGS. 1*a*,*b*. SUBTHURMANNIA MEDIA, sp. nov. Holotype, G. S. I. Type No. 16583, (loc. 687). (Page 50).

FIGS. 2*a*-*c*. SUBTHURMANNIA PATELLA, sp. nov. Holotype, G. S. I. Type No. 16585, (loc. 687). (Page 51).

FIGS. 3-4. SUBTHURMANNIA LISSONIOIDES, sp. nov. Paratype, G. S. I. Type No. 16587, with penultimate whorl (3*a*-*c*), and holotype, G. S. I. Type No. 16586 (4*a*, *b*). (loc. 685). (Page 52).

FIGS. 5*a*,*b*. SUBTHURMANNIA (BERRIASELLA ?) sp. ind. Beginning of body-chamber. N. E. Andavaravina, Madagascar (H. Besairie Coll., B. M. No. C. 39692). (Page 137).

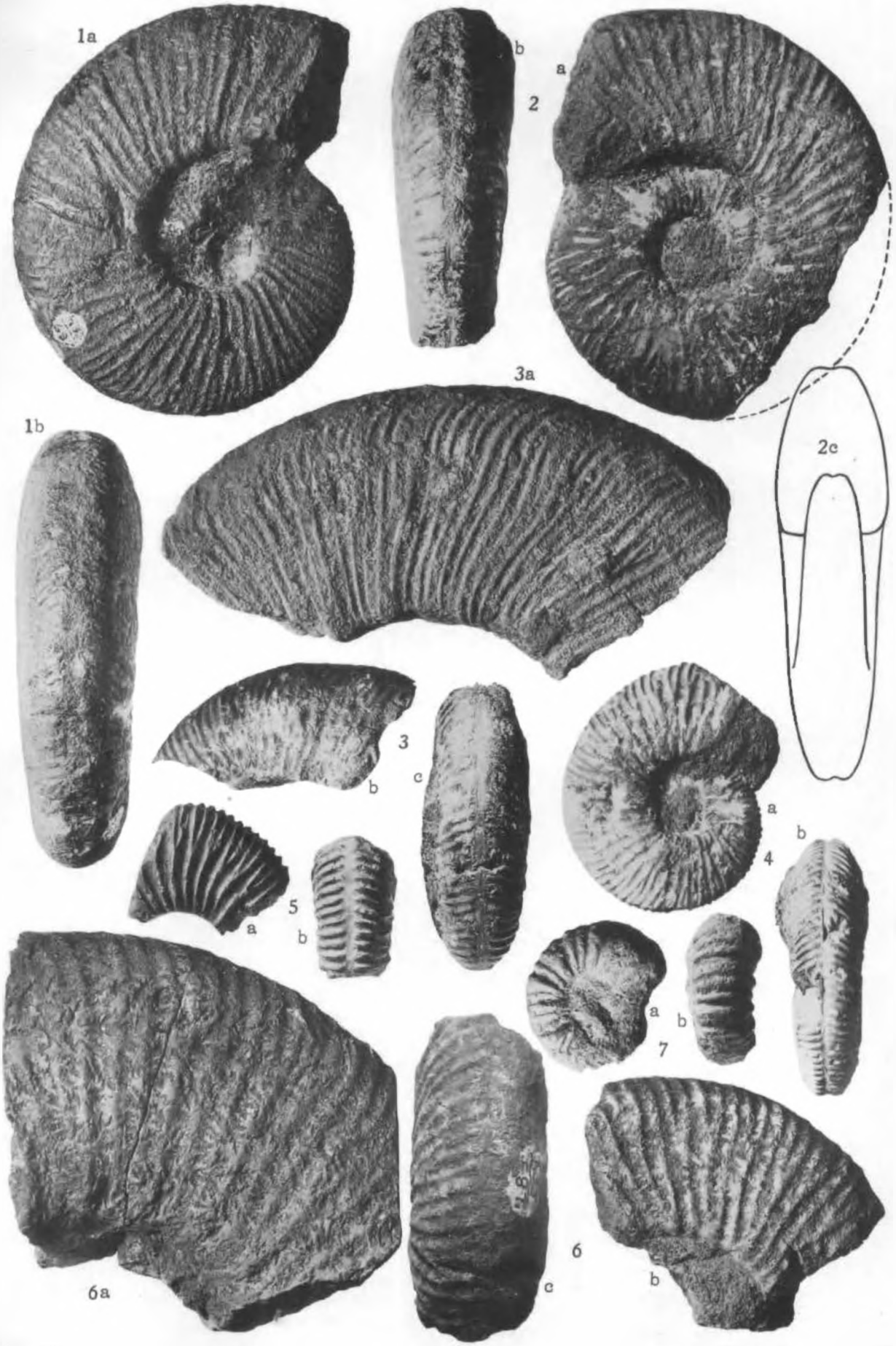
FIGS. 6*a*-*c*. SUBTHURMANNIA, sp. ind. Two fragments (loc. 687). No. K. 33/687 *e'*, *e''*. (Page 54).

FIGS. 7*a*,*b*. ACANTHOHOPLITES sp. Lowest Albian or uppermost Aptian. West of Sheikh Budin, D. I. K. District. (Pinfold Coll., B. M. No. C. 39686.) (Page 120).

All the specimens figured in this plate, except figs. 5 and 7, are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate VIII.



E. J. Manly, photo.

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PLATE IX.

FIG. 1. SUBTHURMANNIA FERMORI, sp. nov. Holotype, G. S. I. Type No. 16589, (loc. 687). For peripheral view see Plate X, fig. 7. (Page 53).

FIGS. 2*a*,*b*. THURMANNITES, sp. ind. Small fragment, the suture-line of which had been figured by Salter and Blanford (1865, Plate XIX, fig. 2; AMM. WALLICHI). Spiti Shales, Himalayas. (B. M. No. C. 7684, Strachey Coll.). (Page 89).

FIG. 3. SUBTHURMANNIA (Gen. nov. ?) cf. PSEUDOPUNCTATA sp. nov. External saddle (reversed) of a large but doubtful fragment, G. S. I. Type No. 16599, (loc. 687). (Page 61).

FIGS. 4*a*,*b*. SUBTHURMANNIA BOISSIERI (Pictet) Uhlig sp. Example figured by Blanford as AMM. WALLICHI. Spiti Shales, Niti Pass, Himalayas. (B. M. No. C. 7675*b*, Strachey Coll.). (Page 51).

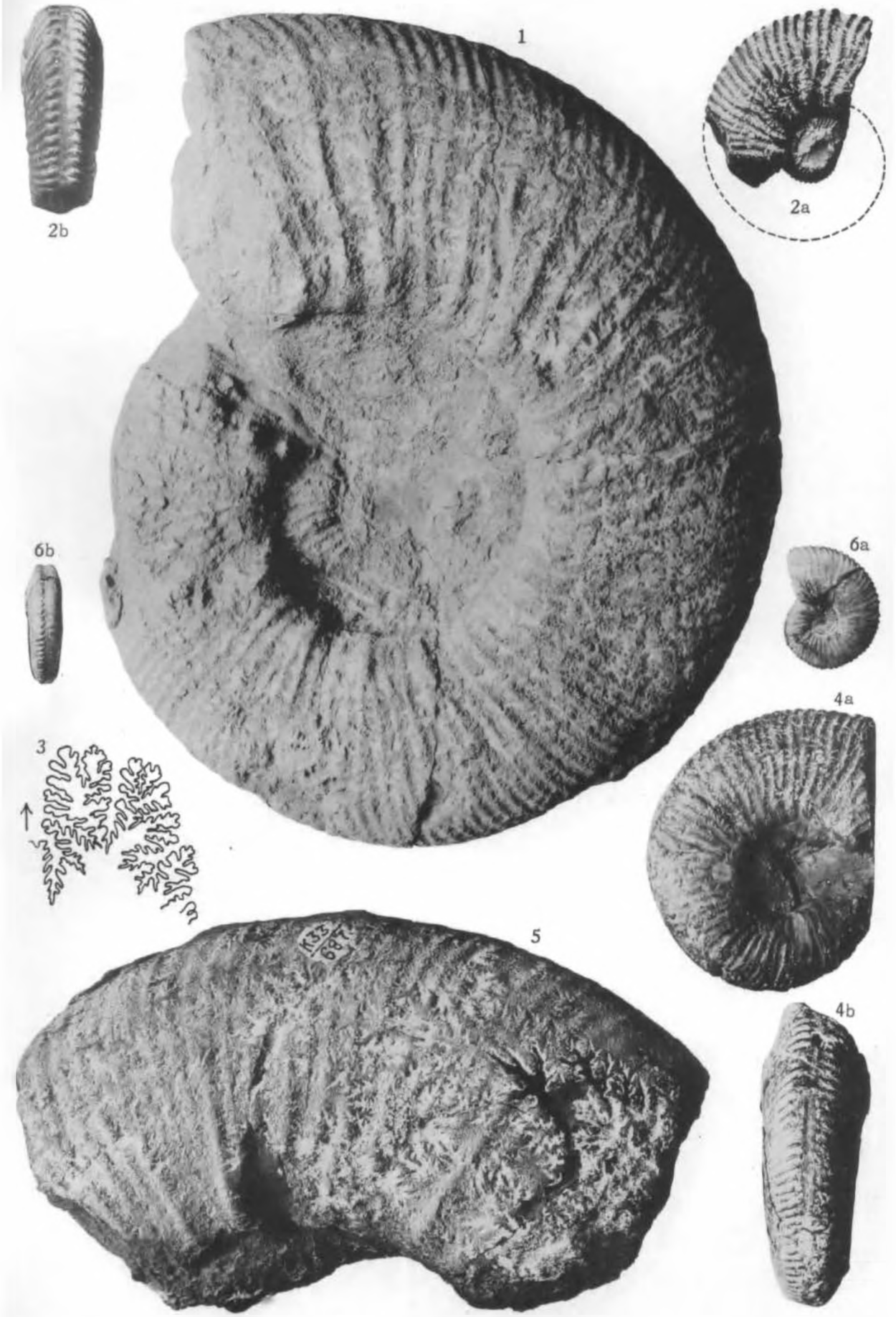
FIG. 5. SUBTHURMANNIA aff. FERMORI, sp. nov. Septate fragment, (loc. 687). G. S. I. Type No. 16592. (Page 53).

FIGS. 6*a*,*b*. Thurmannites (Kilianella ?) sp. nov. Inner whorls (loc. 700). No. K. 33/700*b*". (Page 80).

All the specimens figured in this plate, except figs. 2 and 4, are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate IX.



E. J. Manly, photo.

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PLATE X.

FIGS. 1*a*,*b*. SUBTHURMANNIA aff. FERMORI, sp. nov. Two septate fragments (loc. 687). G. S. I. Type Nos. 16590-91. (Page 53).

FIGS. 2*a*-*c*. NEOCOMITES (THURMANNITES ?) sp. ind. Fragment (*a*), with its inner whorls figured separately (*b*,*c*). (loc. 685). No. K. 33/685*d*. (Page 89).

FIG. 3. SUBTHURMANNIA (BERRIASELLA ?) sp. ind. Doubtful fragment (loc. 687). No. K. 33/687*g*. (Page 56).

FIG. 4. SUBTHURMANNIA sp. Intermediate between S. TRANSITORIA, sp. nov. and S. sp. ind. (loc. 687). No. K. 33/687*e*'''. (Page 58).

FIGS. 5*a*,*b*. KILIANELLA sp. nov. (Transition from BERRIASELLA of the PRIVASENSIS group). Infra-Valanginian. 1 km. N. of Ankaramibi, Madagascar (H. Besairie Coll. B. M. No. C. 39690). (Page 137).

FIG. 6. THURMANNITES (?) sp. ind. cf. pronecostatus (Felix). Peripheral view of a doubtful fragment (loc. 687). No. K. 33/687*n*. (Page 81).

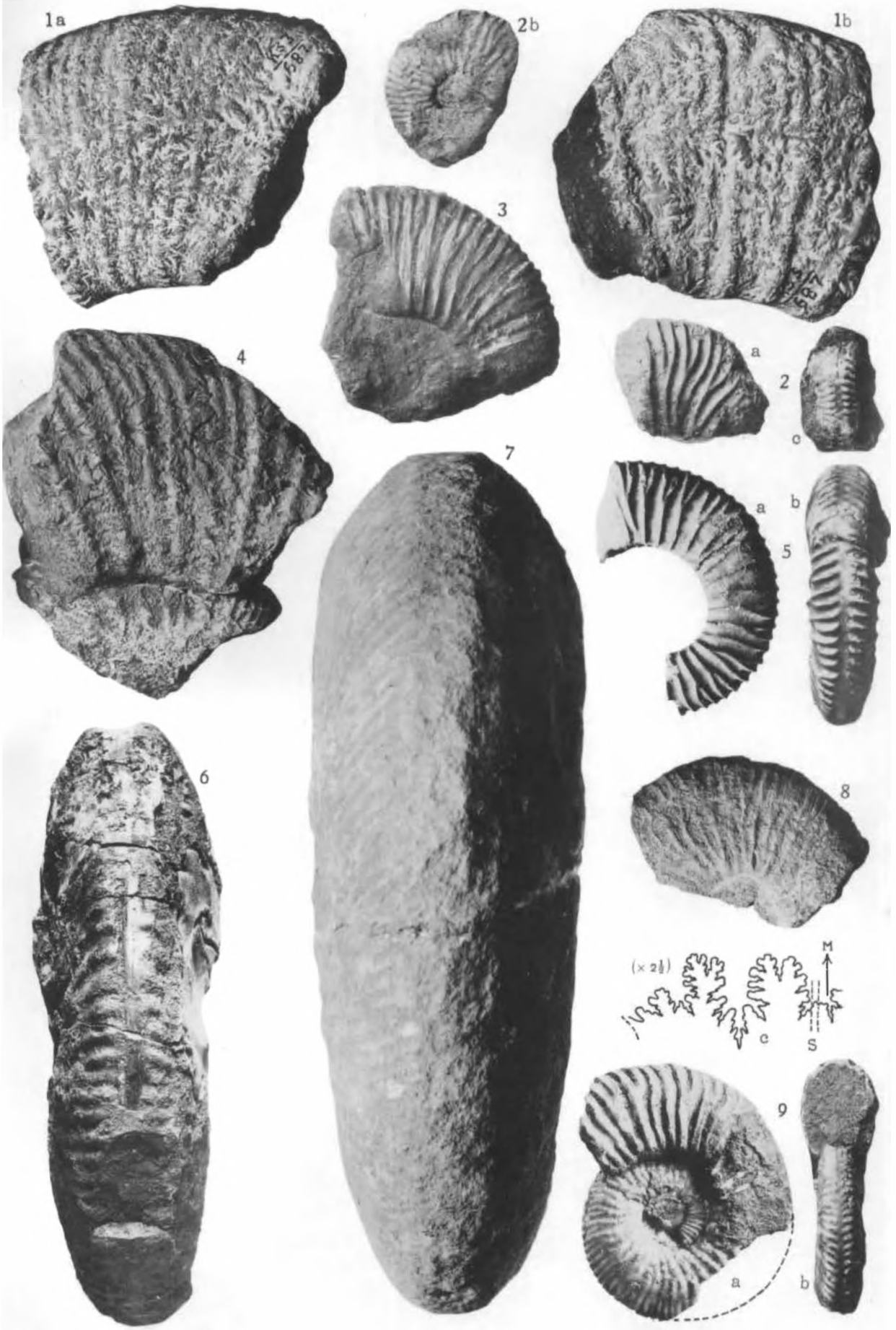
FIGS. 7, 8. SUBTHURMANNIA FERMORI, sp. nov. Peripheral view of holotype, G. S. I. Type No. 16589 (Plate IX, fig. 1), and small, doubtful, fragment G. S. I. Type No. 16593 (loc. 687). (Page 53).

FIGS. 9*a*-*c*. THURMANNITES (KILIANELLA ?) sp. nov. With asymmetrical external suture-line, enlarged × 2½ (loc. 700). No. K. 33/700*b*'. (Page 80).

All the specimens figured in this plate except fig. 5, are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate X.



E. J. Manly, photo.

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PLATE XI.

FIGS. 1*a*,*b*. SUBTHURMANNIA TRANSITORIA, sp. nov. Holotype, G. S. I. Type No. 16594. (loc. 687). (Page 57).

FIGS. 2, 3. SUBTHURMANNIA sp. nov. aff. TRANSITORIA, sp. nov. Large typical (3), and small, doubtful, fragment (2). (loc. 687). Nos. K. 33/687*h*′, *h*″. (Page 58).

FIGS. 4, 5. NEOCOMITES SIMILIS, sp. nov. Holotype, G. S. I. Type No. 16604 (5), and paratype, G. S. I. Type No. 16605 (4). (loc. 687). (Page 83).

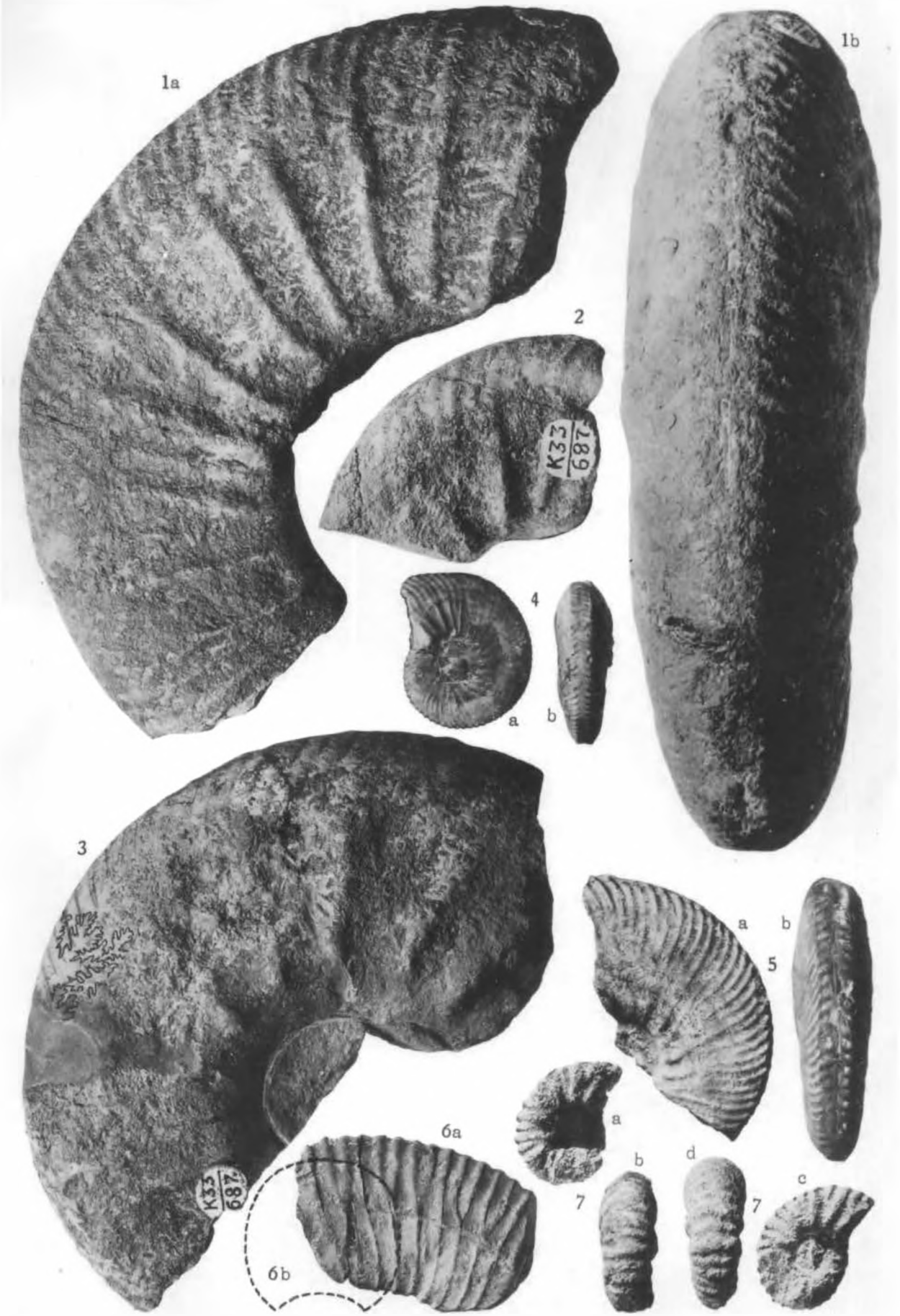
FIGS. 6*a*,*b*. AULACOSPHINCTOIDES sp. (group of A. INFUNDIBULUS, Uhlig sp.). Ex Spiti Shales, Chidamu Stage (derived). (loc. 690). No. K. 33/690*b*. (Page 121).

FIGS. 7*a*-*d*. HUBERTOCERAS sp. ind. (group of H. OMPHALODES, Waagen sp.) Upper Callovian. Limestone below Belemnite Shales, S. Nala of Miranwal, N. of Makerwal Depot Nos. K. 33/720*a*′, *a*″. (Page 120).

All the specimens figured in this plate, except figs. 7*a*, *b*, are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XI.



E. J. Manly, photo.

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PLATE XIII.

FIG. 1. SUBTHURMANNIA, sp. ind. cf. LORENSIS (Lisson). Part of a larger fragment, slightly malformed (loc. 687). No. K. 33/687*f*. (Page 55).

FIG. 2. PARANDICERAS, sp. ind. cf. THEODORII (Oppel). Peripheral view of a fragment (loc. 682). No. K. 33/682*h*. (Page 78).

FIGS. 3*a-d*. PARANDICERAS, sp. nov. ind. Three examples from loc. 700 (*a*, *b*, No. K. 33/700*a*.) 682 (*d* No. K. 33/682*g*), and Malla Khel (*c*, Morris Coll. B. M. No. C. 39669). (Page 78).

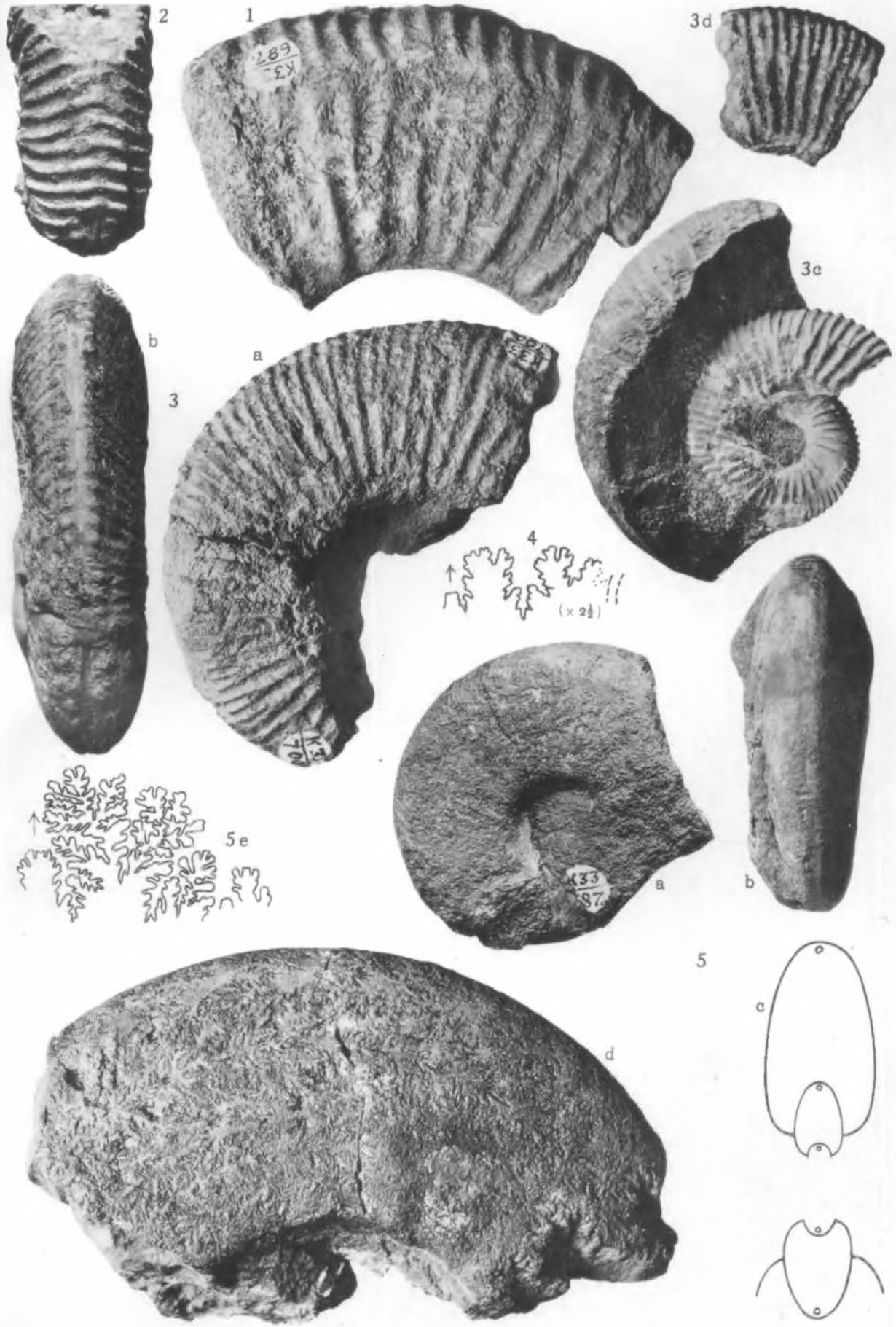
FIG. 4. KILIANELLA ASIATICA, sp. nov. Suture-line, enlarged × 2½, of holotype, G. S. I. Type No. 16608, figured in Plate XIV, fig. 2. (loc. 687). (Page 93).

FIGS. 5*a-e*. SUBTHURMANNIA FILOSA, sp. nov. Holotype, G. S. I. Type No. 16595 (*a*, *b*); outline whorl-section of a paratype, G. S. I. Type No. 16596 (*c*); more doubtful larger fragment (*d*) and external saddle (*e*) of largest example (loc. 687 [*a-c*] and Baroch Nala, Malla Khel [*d*, *e*, B. M. Nos. C. 39664-65]). (Page 59).

All the examples figured in this plate are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XIII



E. J. Manly, photo

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PLATE XIV.

FIGS. 1*a*,*b*. SARASINELLA UHLIGI, sp. nov. Holotype. Chichali Hills (B. M. No. C. 94). (Page 99).

FIGS. 2*a*,*b*. KILIANELLA ASIATICA, sp. nov. Holotype, G. S. I. Type No. 16608, (loc. 687). For suture-line see Plate XIII, fig. 4. (Page 93).

FIGS. 3*a*,*b*. SUBTHURMANNIA (BERRIASELLA) sp. ind. Body-chamber fragment. Infra-Valanginian. N. E. Andavaravina, Madagascar (H. Besairie Coll., B. M. No. C. 39691). (Page 137).

FIGS. 4, 5. RAIMONDICERAS (?) SALINARIUM, sp. nov. Holotype and paratype fragments (loc. 687). G. S. I. Type Nos. 16600-601. (Page 62).

FIGS. 6*a*,*c*. SUBTHURMANNIA (Gen. nov. ?) PSEUDOPUNCTATA, sp. nov. Holotype, G. S. I. type No. 16597 (*a*) with outline whorl-section (*b*) and doubtful, larger, fragment, G. S. I. Type No. 16598 (*c*). (loc. 687). (Page 61).

FIGS. 7*a*,*b*. NEOCOMITES (PARANDICERAS ?) aff. INDICUS, Uhlig. Example figured by Blanford (1865, Plate XIX, figs. 1*a*, *b*, reversed and restored). Spiti Shales, Niti Pass, Himalayas (B. M. No. C. 7675*a*, Strachey Coll.). (Page 77).

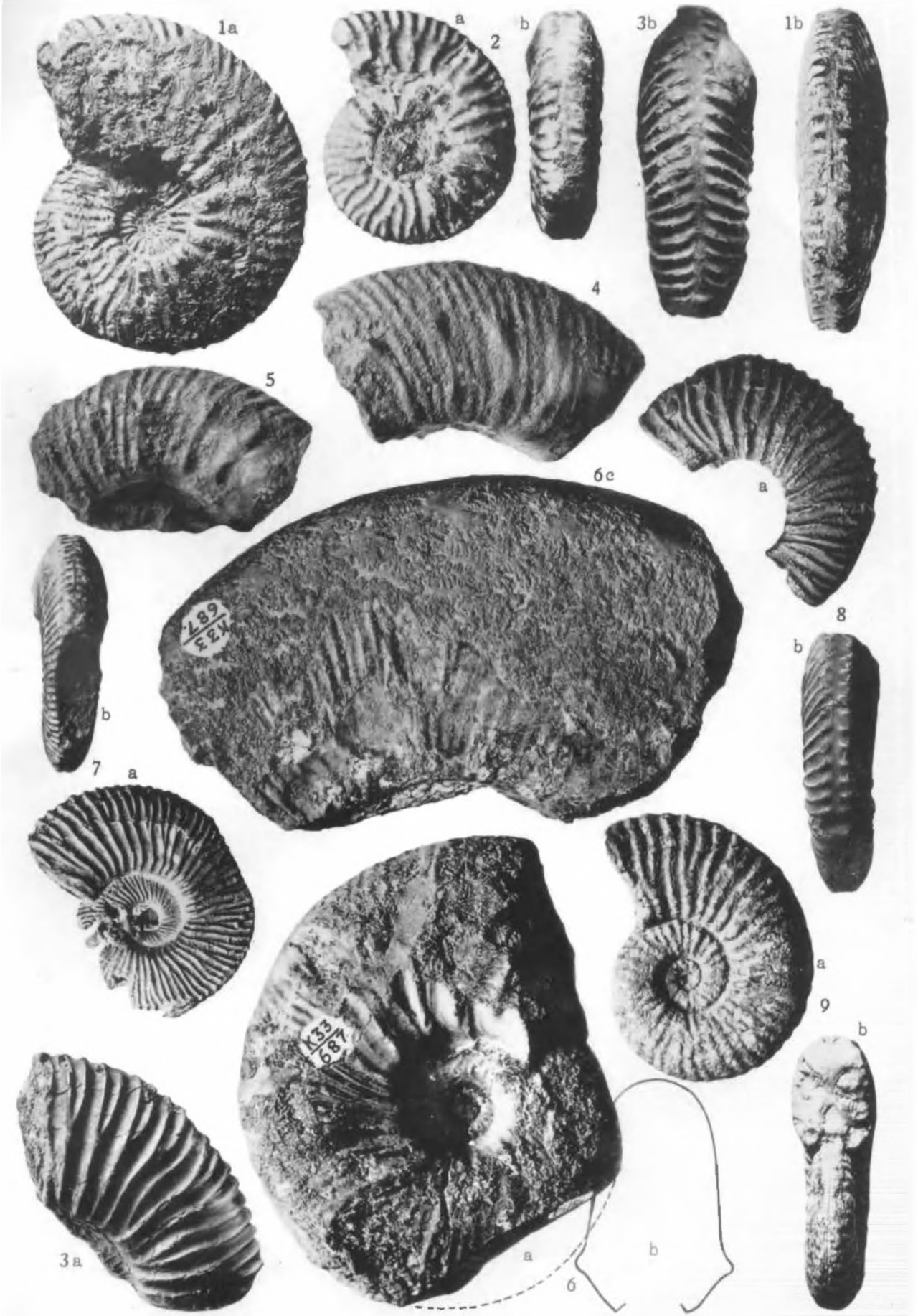
FIGS. 8*a*,*b*. THURMANNITES KINGI (Uhlig). Small body-chamber fragment. Spiti Shales, Lochambel Stage. Niti Pass, Himalayas(B. M. No. C. 7675*c*, Strachey Coll.). (Page 77).

FIGS. 9*a*,*b*. SARASINELLA (?) sp. ind. nov. ? Weathered example (loc. 687). No. K. 33/687*r*. (Page 102).

All the specimens figured in this plate, except figs. 3, 7 and 8, are from the Neocomian Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XIV.



E. J. Manly, photo.

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PLATE XV.

FIGS. 1*a,b*. PARANDICERAS ROTA, sp. nov. Holotype, G. S. I. Type No. 16603. (loc. 700). (Page 77).

FIGS. 2*a,b*. NEOCOMITES (ODONTODISCOCERAS ?) sp. ind. cf. MONTANUS, Uhlig. Worn example, from Malla Khel (Morris Coll., B. M. No. C. 39670). (Page 91).

FIGS. 3, 4. RAIMONDICERAS, sp. nov. Slightly crushed young and larger septate fragment. Lower Neocomian, South America (exact locality unknown). (B. M. No. C. 4269*a*, *b*). (Page 63).

FIGS. 5*a-b*. NEOCOMITES, sp. nov. cf. TESCHENENSIS (Uhlig). Fragment, with last septal edge. (loc. 687). No. K. 33/687*p*. (Page 86).

FIGS. 6*a-c*. NEOCOMITES, sp. nov. cf. TESCHENENSIS (Uhlig). Similar fragment, with squeeze of dorsal area. Infra-Valanginian. 1 km. N. of Ankaramibe, Madagascar (H. Besairie Coll. B., M. No. C. 39693). (Page 137).

FIG. 7. SUBTHURMANNIA, sp. ind. cf. LORENSIS (Lisson). Peripheral view of the fragment figured in Plate XII, fig. 4 (loc. 682). No. K. 33/682*d''*. (Page 55).

FIGS. 8*a,b*. AULACOSPHINCTOIDES aff. UHLIGI, Spath. Ex Spiti Shales, Chidamu Stage (loc. 682). No. K. 33/682*l*. (Page 120).

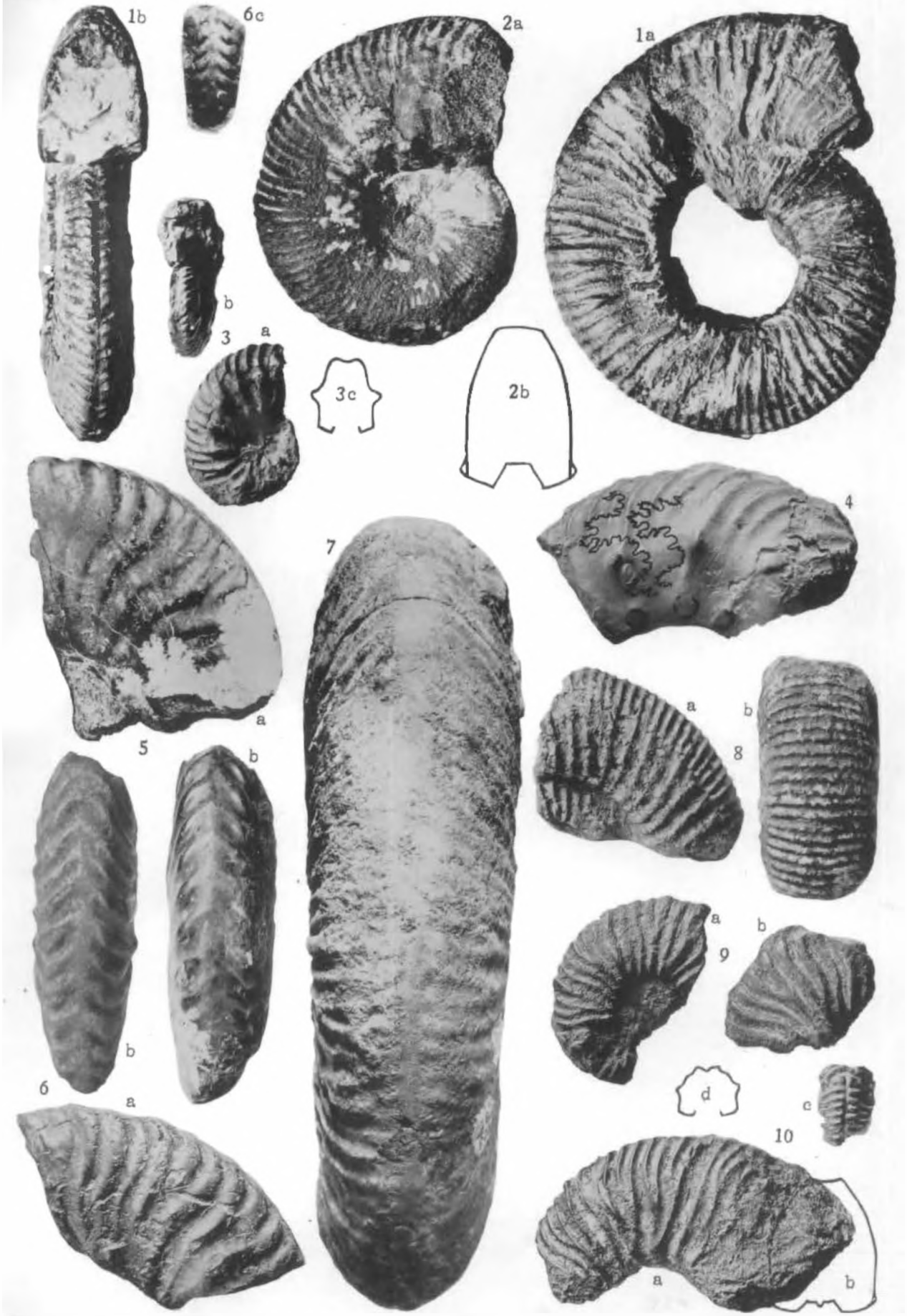
FIGS. 9*a,b*. NEOCOMITES, sp. nov. aff. PLATYCOSTATUS (Sayn). Two fragments (loc. 687). Nos. K. 33/687*o'*, *o'* . (Page 84).

FIGS. 10*a-d*. NEOHOPLOCERAS (?) sp. ind. Fragment, with inner whorls (*c*) and outline whorl-sections of both (loc. 687). No. K. 33/687*u*. (Page 108).

All the specimens figured in this plate, except figs. 3, 4 and 6, are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XV.



E. J. Manly, photo.

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PLATE XVI.

FIGS. 1*a-d*. NEOHOPLOCERAS SUBMARTINI (Mallada). Septate example, No. K. 33/687*s*, with inner whorls (*c*) and suture-line, enlarged $\times 1\frac{1}{2}$ and slightly diagrammatic (*d*) (loc. 687). (Page 105).

FIGS. 2*a,b*. SARASINELLA SUBSPINOSA (Uhlig). Small example. Spiti Shales, Lochambel Stage, Himalayas. B. M. Geol. Soc. Coll. No. 10082 (ex Hardwicke, Wallich and Colebrooke Colls.). (Page 100).

FIGS. 3*a,b*. KILIANELLA ? ("ACANTHODISCUS") sp. nov. cf. LAMBERTI (Sayn). Septate fragment (loc. 687). No. K. 33/687*q*. (Page 98).

FIGS. 4*a,b*. KILIANELLA BESAIRIEI, sp. nov. Holotype, G. S. I. Type No. 16609 (loc. 687). (Page 96).

FIGS. 5*a-c*. KILIANELLA BESAIRIEI, sp. nov. Body-chamber fragment. Infra-Valanginian. 1 km. N. of Ankaramibe, Madagascar (H. Besairie Coll., B. M. No. C. 39694). (Page 137).

FIG. 6. DISTOLOCERAS ? sp. ind. Doubtful fragment (loc. 682). No. K. 33/682*k*. (Page 109).

FIGS. 7*a,b*. RAIMONDICERAS, sp. ind. Body-chamber fragment, with LISSONIA periphery. Lower Neocomian, Velez, Colombia (B. M. No. C. 4268). (Page 63).

FIGS. 8*a,b*. AULACOSPHINCTOIDES, sp. ind. Ex Spiti Shales, Chidamu Stage. Makerwal Colliery (Pinfold Coll. B. M. No. C. 39688). (Page 120).

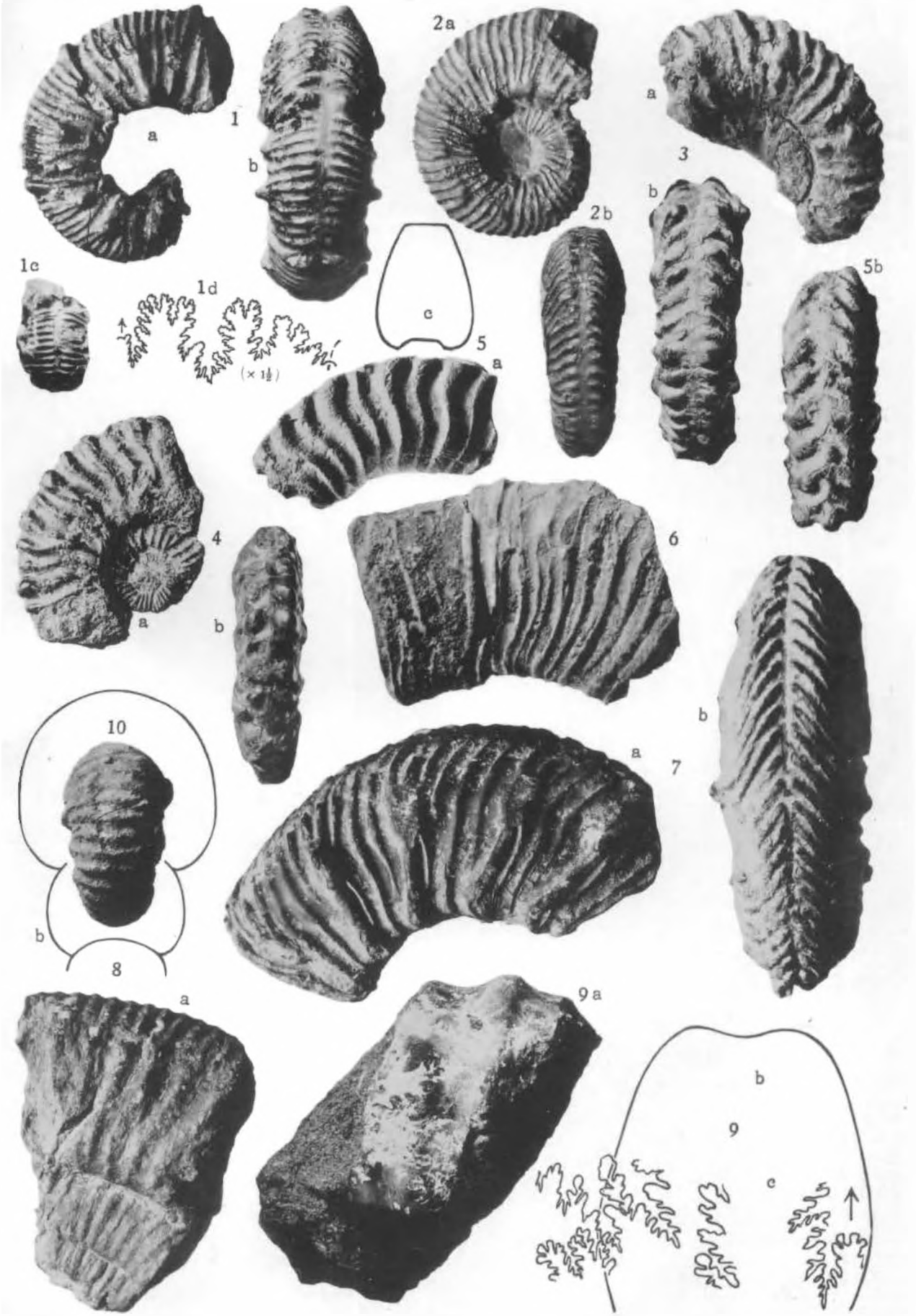
FIGS. 9*a-c*. NEOCOSMOCERAS ? ("ACANTHODISCUS") sp. ind. Doubtful fragment, with outline whorl-section and parts of suture-line (loc. 687). No. K. 33/687*l*. (Page 72).

FIG. 10. OBTUSICOSTITES, sp. juv. Limestone below Belemnite Beds. Upper Callovian, Miranwal Nala, Makerwal (K 35/49). For side-view see Plate XVII, fig. 9. No. K. 35/49*a*. (Page 120).

The specimens figured in figs. 1, 3, 4, 6, 8 and 9 are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XVI.



E. J. Manly, photo

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PLATE XVII.

FIGS. 1*a,b*. NEOCOMITES ? sp. nov. (group of N. PLATYCOSTATUS, Sayn ?). With TARAMELLICERAS-like outer whorl. ROGERSITES beds, N. W. of Ambiky, Madagascar (H. Besairie Coll., B. M. No. C. 39695). (Page 138).

FIGS. 2*a,b*. NEOCOMITES (LYTICOCERAS ?) sp. nov. Doubtful fragment (loc. 690). No. K. 33/690*a*. (Page 90).

FIG. 3. NEOCOMITES (?) sp. ind. cf. SCIOPTYCHUS (Uhlig). Ventral view (not quite central) of a large fragment (loc. 682). No. K. 63/682*j*. (Page 89).

FIGS. 4*a,b*. NEOCOMITES sp. nov. aff. PLATYCOSTATUS, Sayn. Side-view of a fragment (*a*), and ventral view of another (*b*), with slightly wider periphery (locs. 685 [No. K. 33/685*c*] and 687 [No. K. 33/687*o*'''']). (Page 84).

FIGS. 5*a,b*. NEOCOMITES (LEOPOLDIA ?) sp. nov. ? More coarsely ribbed form than the next (fig. 6). ROGERSITES beds. N. W. of Ambiky, Madagascar (H. Besairie Coll., B. M. No. C. 39696). (Page 138).

FIGS. 6*a,b*. NEOCOMITES (LEOPOLDIA ?) cf. QUADRISTRANGULATUS (Sayn). Same locality and collection. B. M. No. C. 39697. (Page 138).

FIGS. 7*a,b*. THURMANNITES (NEOCOMITES) MADAGASCARIENSIS (Besairie). Same beds and collection. B. M. No. C. 39698. (Page 138).

FIGS. 8*a-d*. NEOHOPLOCERAS, sp. nov. Fragment, with separated inner whorls (*c*) and outline whorl-section of latter (loc. 687). No. K. 33/687*t*. (Page 107).

FIG. 9. OBTUSICOSTITES, sp. juv. Side-view of example figured in Plate XVI, fig. 10. Limestone below Belemnite Beds, Miranwal Nala, Makerwal (No. K 35/49*a*). (Page 120).

FIGS. 10*a,b*. SARASINELLA, sp. nov. ? aff. TREZANENSIS (Sayn). Body-chamber example. ROGERSITES beds, N. W. of Ambiky, Madagascar (H. Besairie Coll., B. M. No. C. 39699). (Page 138).

The specimens figured in figs. 2, 3, 4 and 8 are from the Belemnite Beds of the Trans-Indus Range.

Geol. Surv. of India

Plate XVII.

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PLATE XVIII.

FIGS. 1*a*,*b*. NEOCOMITES (CALLIPTYCHOCERAS ?) PSEUDOVICARIUS, sp. nov. Holotype, G. S. I. Type No. 16607 (loc. 700). (Page 92).

FIGS. 2*a*,*b*. KINKELINICERAS, sp. ind. (group of K. ANGYGASTER, Waagen sp.). Limestone below *Belemnite* Shales, upper ANCEPS zone (loc. 704). No. K 35/49*b*. (Page 120).

FIG. 3. PARANDICERAS (?) THEODORII (Oppel). Septate example (loc. 814). No. K. 35/814*a*. (Page 78).

FIGS. 4*a*,*b*. NEOCOSMOCERAS, sp. nov. Septate fragment (loc. 768). No. K. 35/678*c*. (Page 68).

FIGS. 5*a*,*b*. NEOCOMITES (LYTICOCERAS ?) sp. nov. Corroded fragment (near loc. 682). No. K. 35/56. (Page 90).

FIGS. 6*a*,*b*. NEOCOMITES SIMILIS, sp. nov., var. INAEQUALIS, nov. G. S. I. Type No. 16606. Transitional to N. cf. PLATYCOSTATUS, Sayn (K 35/55, near loc. 682). (Page 83).

FIGS. 7*a*,*b*. BLANFORDICERAS (Gen. nov. ?) sp. nov. Septate fragment (loc. 768). No. K. 35/768*a*. (Page 47).

FIGS. 8*a*,*b*. HILDOGLOCHICERAS, sp. ind. (group of H. PROPINQUUM, Waagen sp.). Worn example (ex Spiti Shales, Chidamu Stage, loc. 768). No. K. 35/768*b*. (Page 124).

FIGS. 9*a*,*b*; 10. OLCOSTEPHANUS (ROGERSITES) SCHENKI (Oppel). Two typical examples, septate (9) and body-chamber (10). (Nos. K 35/53*a* and K 35/58*a*, near loc. 682). (Page 30).

All the examples figured in this plate, except 2 and 8, are from the Belemnite Beds of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate XVIII.

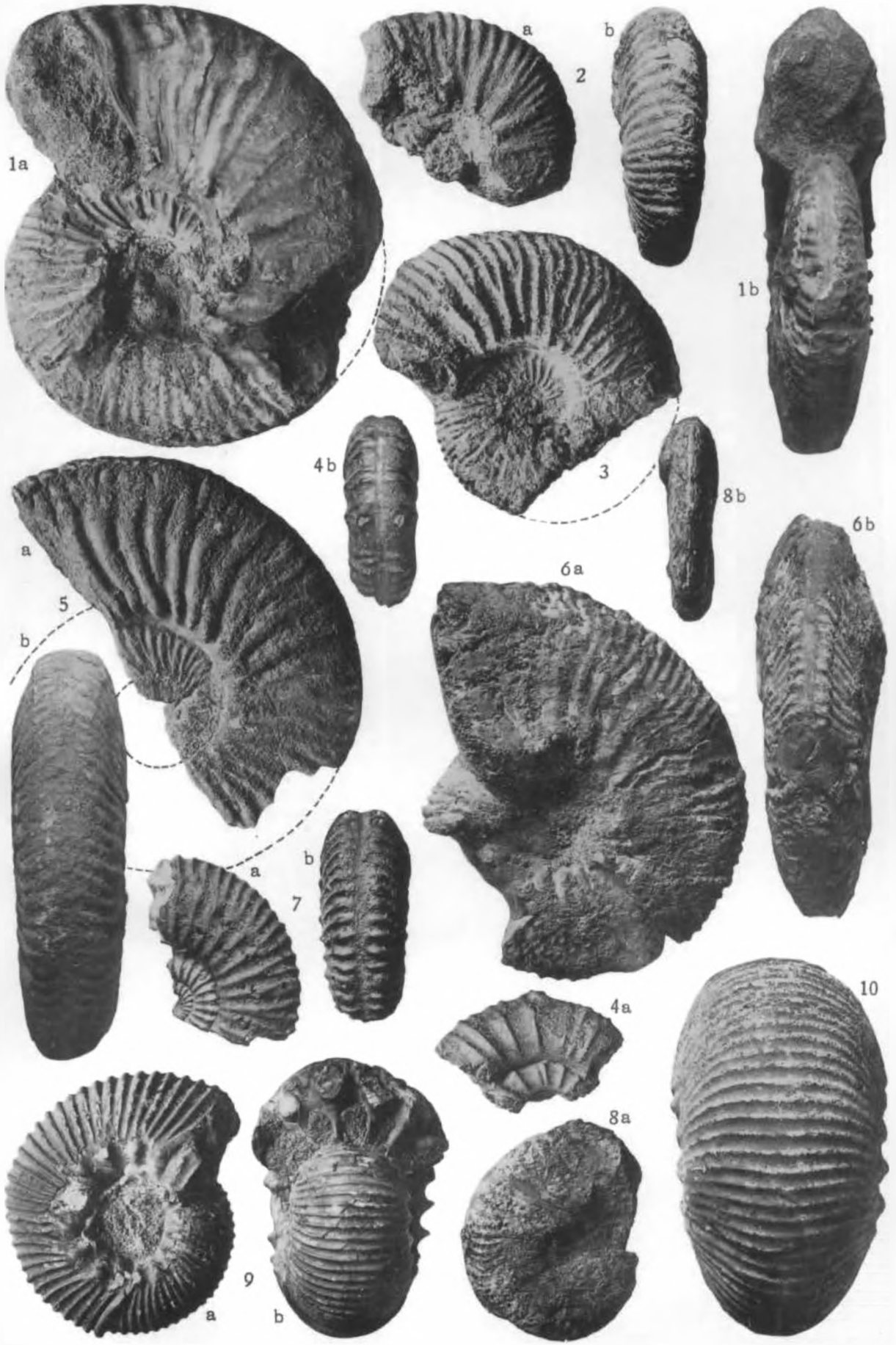

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PLATE XIX.

FIGS. 1*a,b*. PTEROLYTOCERAS ? PUNJABENSE (Folgner MS.) sp. nov. Holotype, G. S. I. Type, No. 16554. (Page 6).

FIGS. 2*a,b*. OLCOSTEPHANUS SUBLAEVIS, sp. nov. (Slightly crushed at end). G. S. I. Type, No 16575. (Page 21).

FIGS. 3*a,b*. OLCOSTEPHANUS cf. MADAGASCARIENSIS, Lemoine. With outline whorl-section. No. G. 344/13*a*. (Page 28).

FIGS. 4*a,b*. OLCOSTEPHANUS aff. SALINARIUS, sp. nov. Young example, G. S. I. Type, No. 16563. (Page 13).

FIG. 5. OLCOSTEPHANUS PACHYCYCLUS (Folgner MS.) sp. nov. Paratype, G. S. I. Type, No. 16577. (Page 23).

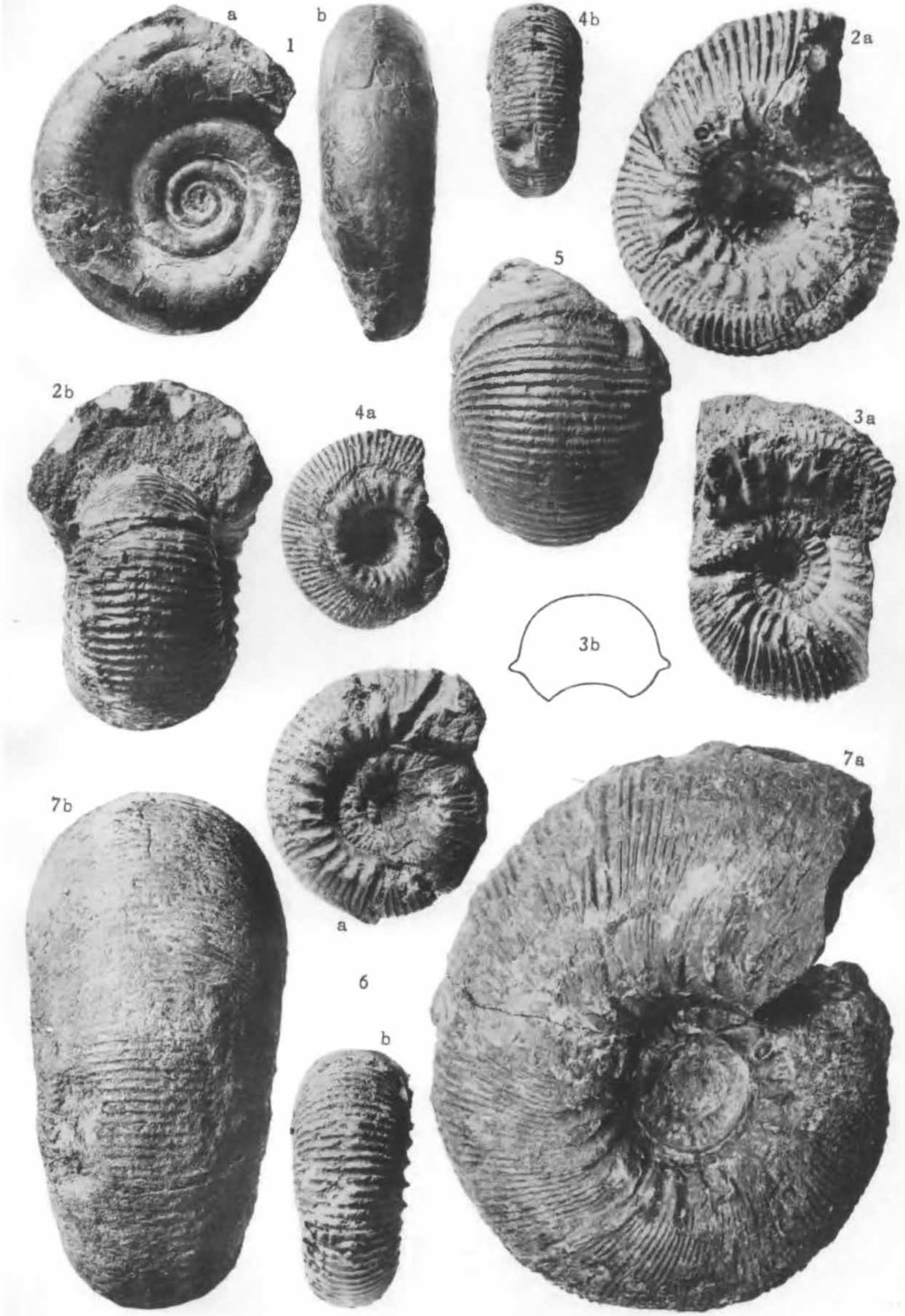
FIGS. 6*a,b*. OLCOSTEPHANUS WYNNEI (Folgner MS.) sp. nov. Holotype, G. S. I. Type, No. 16581. (Page 29).

FIGS. 7*a,b*. OLCOSTEPHANUS VICTORIS (Folgner MS.) sp. nov. Holotype, G. S. I. Type, Nos. 16569 Side-view) and paratype, G. S. I. Type, No. 16570 (peripheral view). (Page 20).

All the examples figured in this plate are from the Neocomian Belemnite Marls of the Trans-Indus Salt Range, 1 from Mallakhel, 2-7 from the Chichali Pass (Wynne collection).

Geol. Surv. of India

Plate XIX.



E. J. Manly, photo.

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PLATE XX.

FIGS. 1*a*,*b*. OLCOSTEPHANUS PACHYCYCLUS (Folgner MS.) sp. nov. Holotype, G. S. I. Type, No. 16576. (Page 23).

FIGS. 2*a*,*b*. OLCOSTEPHANUS sp. juv. cf. SALINARIUS, sp. nov. Inner whorls. G. S. I. Type, No. 16564. (Page 13).

FIG. 3. OLCOSTEPHANUS (ROGERSITES) aff. ATHERSTONI (Sharpe). Slender example, with flattened venter. No. G. 344/13*b*. (Page 32).

FIGS. 4*a*,*b*. OLCOSTEPHANUS (ROGERSITES) ATHERSTONI (Sharpe). Holotype, with sectional outline, from Sundays River, South Africa. Figured Trans. Geol. Soc., vii, 1856, pl. XXIII, fig. 1. B. M. (Geol. Soc. Coll. No. C. 32202). (Page 33).

FIGS. 5*a*,*b*. SUBTHURMANNIA sp. juv. (aff. MEDIA, sp. nov.). Inner whorls, accidentally displaced at end. G. S. I. Type, No. 16584. (Page 50).

FIGS. 6*a*,*b*. PUTEALICERAS sp. (group of P. TRILINEATUM, Waagen sp.). "SCHLOENBACHIA sp. nov." in Folgner. Upper Callovian (derived). Chichali Pass. No. G. 344/13*l*. (Page 117).

FIGS. 7*a*,*b*. BLANFORDICERAS (Gen. nov. ?) sp. nov. Fragment showing suture-line. Belemnite Beds of Mallakhel. No. G. 344/13*c*. (Page 47).

The originals of figs. 1-3 and 5 are from the Neocomian Belemnite Beds of the Chichali Pass, Trans-Indus Salt Range. Wynne Collection.

Geol. Surv. of India

Plate XX.

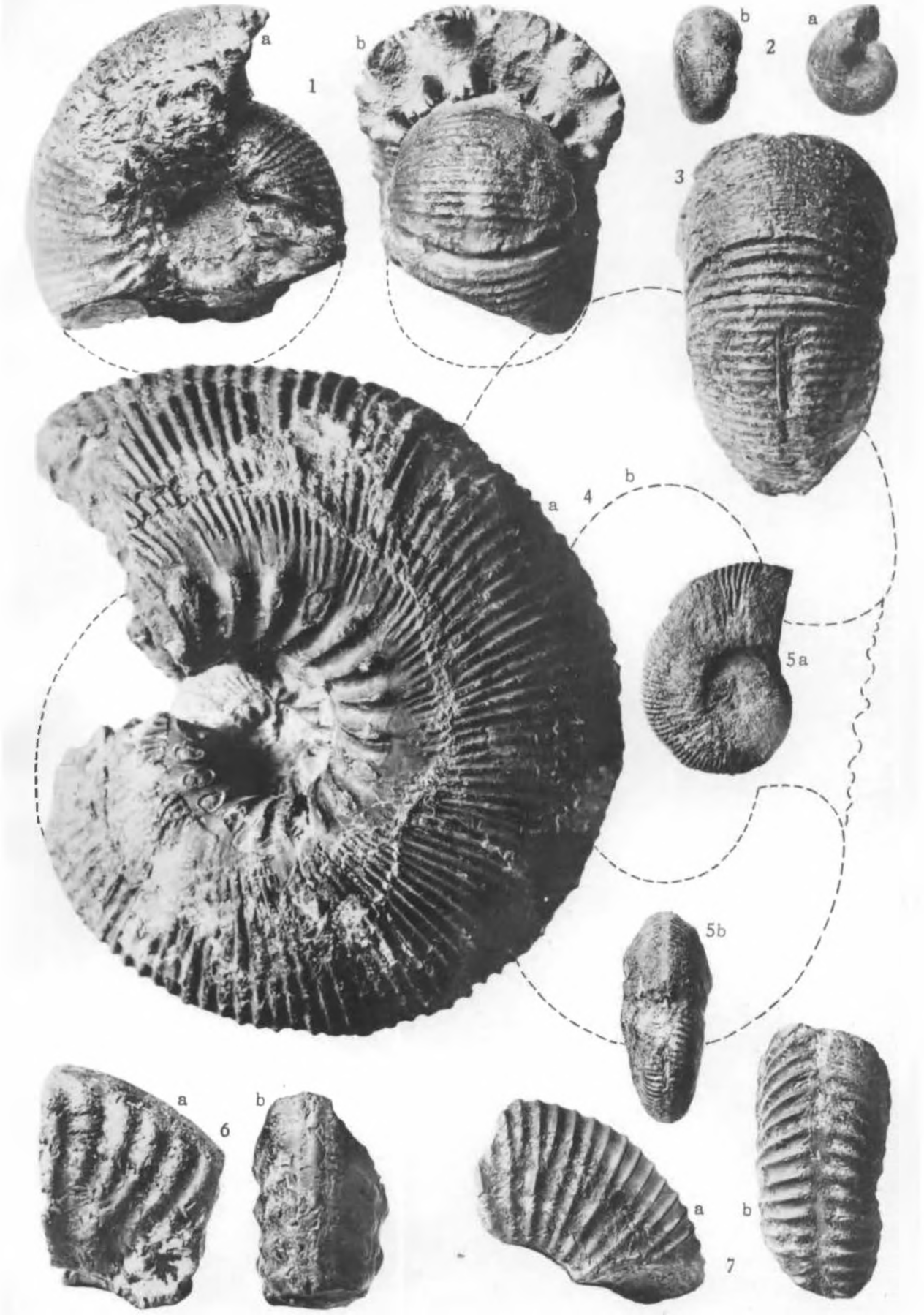

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PLATE XXI.

FIGS. 1*a-c*. NEOCOSMOCERAS HOPLOPHORUM (Folgner MS.) sp. nov. Holotype, G. S. I. Type, No. 16602, with suture-line. (Page 71).

FIGS. 2*a,b*. SUBTHURMANNIA aff. LISSONIOIDES, sp. nov. Body-chamber fragment. G. S. I. Type, No. 16588. (Page 52).

FIG. 3. SARASINELLA CHICHALENSIS (Folgner MS.), sp. nov. Holotype, G. S. I. Type, No. 16613. (Page 101).

FIGS. 4*a-c*. SARASINELLA CHICHALENSIS (Folgner MS.), sp. nov. Paratype, G. S. I. Type, No. 16614. (4*b* fits into dorsal area of 4*a*). (Page 101).

FIGS. 5*a,b*. SARASINELLA UHLIGI, sp. nov., var. ELEGANS, nov. Typical example of variety. G. S. I. Type, No. 16610. (Page 99).

FIGS. 6*a,b*. SARASINELLA cf. UHLIGI, sp. nov. Inner whorls. G. S. I. Type, No. 16611. (Page 99).

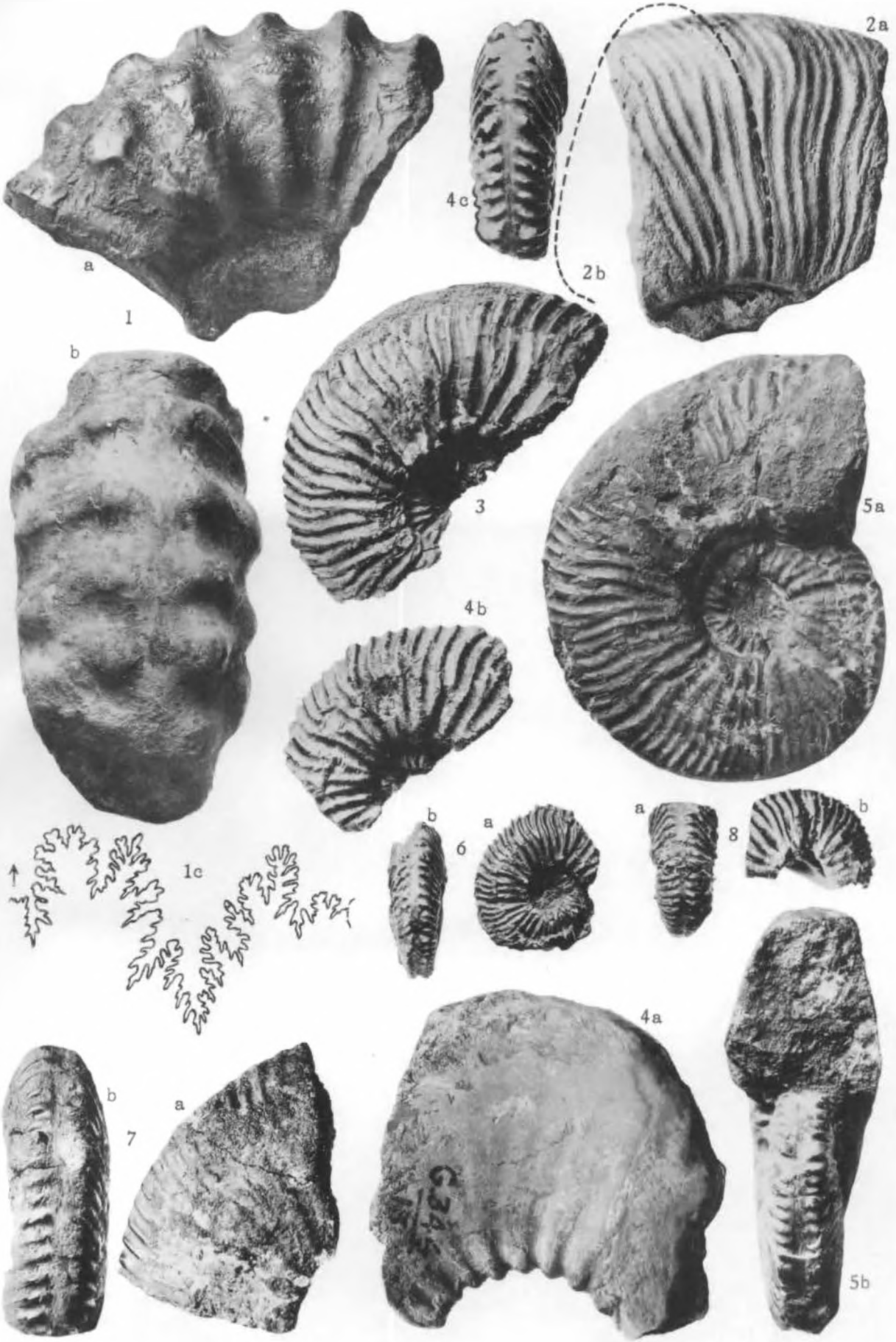
FIGS. 7*a,b*. THURMANNITES (?) sp. ind. Doubtful fragment. No. G. 344/13*n*. (Page 82).

FIGS. 8*a,b*. NEOHOPLOCERAS (?) sp. ind. Trituberculate inner whorls. No. G. 344/13*k*. (Page 108).

All the specimens figured in this plate are from the Neocomian Belemnite Beds of Chichali Pass, Trans-Indus Salt Range. Wynne Collection.

Geol. Surv. of India

Plate XXI.



E. J. Manly, photo

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PLATE XXII.

FIGS. 1*a,b*. KILIANELLA cf. PEXIPTYCHA (Uhlig). Poorly preserved example, with ribbing inaccurately restored. No. G. 344/13*f'*. (Page 95).

FIGS. 2*a,b*. KILIANELLA cf. PEXIPTYCHA (Uhlig). Another fragment, with slight lateral tubercles. No. G. 344/13*f''*. (Page 95).

FIGS. 3*a,b*. NEOHOPLOCERAS BAUMBERGERI (Folgner MS.), sp. nov. Holotype, G. S. I. Type, No. 16615. (Page 106).

FIGS. 4*a,b*. SARASINELLA aff. UHLIGI, sp. nov. Inner whorls, with prominent lateral tubercles. G. S. I. Type, No. 16612. (Page 99).

FIGS. 5*a,b*. SARASINELLA aff. CAMPYLOTOXA (Uhlig). Fragment showing suture-line. No. G. 344/13*i'*. (Page 103).

FIGS. 6*a,b*. KILIANELLA ? ("ACANTHODISCUS") sp. nov. cf. LAMBERTI (Sayn). Doubtful fragment. No. G. 344/13*g*. (Page 98).

FIGS. 7*a,b*. NEOCOMITES (THURMANNITES ?) sp. ind. Fragment, with impression of inner whorls. No. G. 344/13*e*. (Page 89).

FIGS. 8*a,b*. SARASINELLA (?) sp. ind. nov. ? Malformed fragment. No. G. 344/13*h* (Page 102).

FIG. 9. SARASINELLA aff. CAMPYLOTOXA (Uhlig). Fragment with suture-line, like fig. 5. No. G. 344/13*i''*. (Page 103).

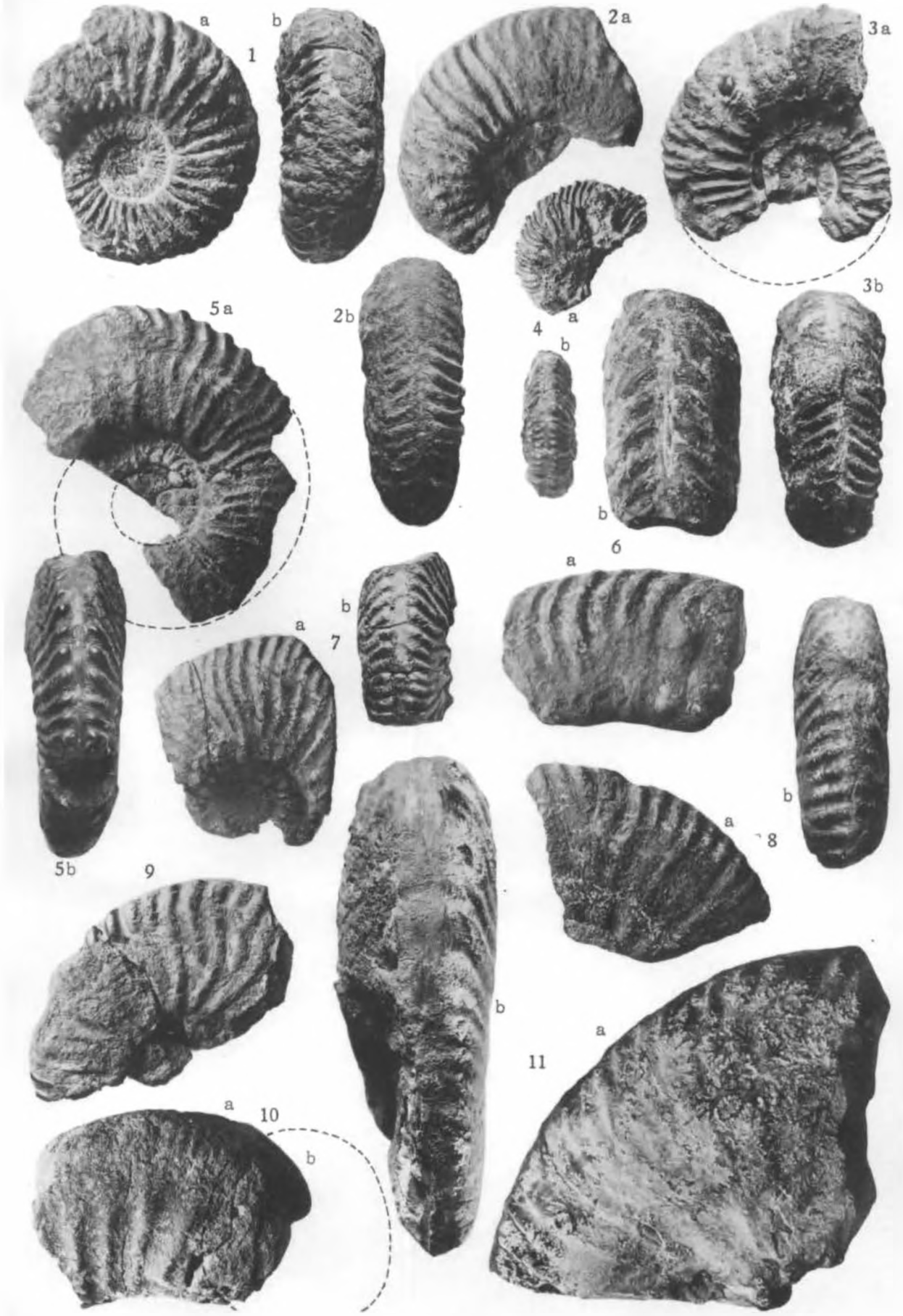
FIGS. 10*a,b*. VIRGATOSPHINCTES sp. cf. BROILII, Uhlig. Derived fragment, with outline whorl-section. Upper Jurassic. Chichali Pass. No. G. 344/13*m*. (Page 117).

FIGS. 11*a,b*. NEOCOMITES aff. NEOCOMIENSIFORMIS (Hohenegger MS.) Uhlig sp. Fragment with suture-line. No. G. 344/13*d*. (Page 87).

The originals of figs. 1-9 and 11 are from the Neocomian Belemnite Beds of the Chichali Pass, Trans-Indus Salt Range. Wynne Collection.

Geol. Surv. of India

Plate XXII.



E. J. Manly, photo.

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PLATE XXIII.

FIGS. 1-14. HIBOLITES SUBFUSIFORMIS (Raspail). (Page 111).

Slender examples with short ventral groove (1-3, 9 and 12) and var. BALUCHISTANENSIS, Noetling (4-8), also doubtful young (10), phragmocone of a large example, probably of the var. BALUCHISTANENSIS (11), and transitions to H. PISTILLIFORMIS (13-14).

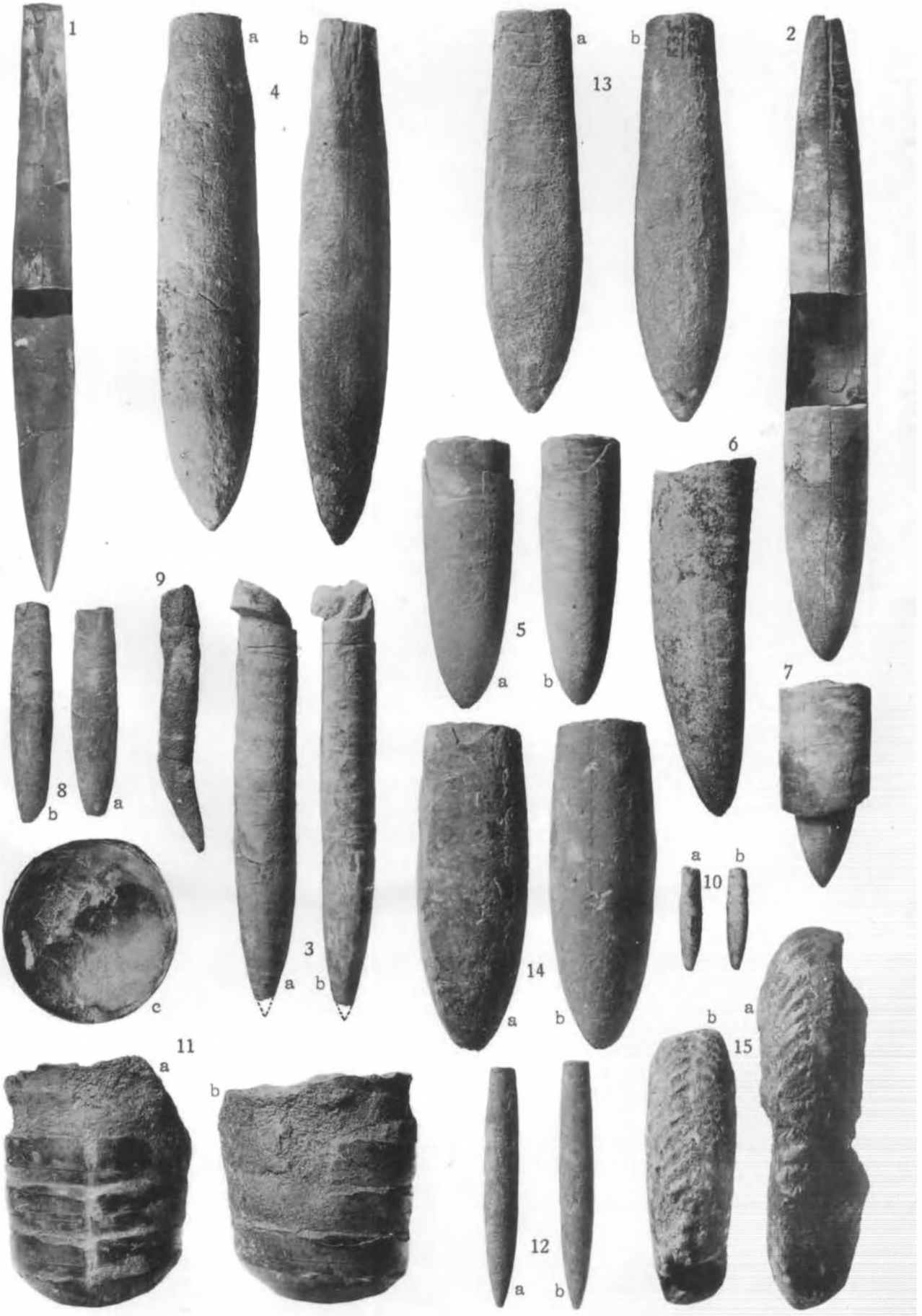
(1, 2, and 11*a* are ventral views, 3*a*, 4*a*, 5*a*, 7, 8*a*, 10*a*, 12*a*, 13*a*, and 14*a* are in the ventro-dorsal direction, 3*b*, 4*b*, 5*b*, 6, 8*b*, 9, 10*b*, 11*b*, 12*b*, 13*b*, and 14*b* are lateral views; the siphuncle in 11*c* is at the bottom).

With the exception of the original of fig. 1 (from the Lower Valanginian of N. E. of Andavaravina, Madagascar, H. Besairie Coll., No. 601=H. JOLEAUDI, Besairie ?) all the examples are from the Neocomian Belemnite Beds of the Trans-Indus Range [North of Kalabagh, 9 and 10 =K. 35/812*a*; 3, 7 and 12=K. 35/813*a*. North of Kuch, 2=K. 35/779*a*. Locality 682 (13=K. 35/792*a*); loc. 687 (11=K. 33/689*a*); loc. 690 (14=K. 33/691*a*); loc. 699 (4, 5, 6, 8=K. 33/697*a*)].

FIGS. 15*a*,*b*. NEOCOMITES, sp. nov. ind. cf. NORICIFORMIS (Hohenegger MS.) Two portions of periphery of outer whorl (loc. 682). No. K. 33/682*i*. (Page 87).

Geol. Surv. of India

Plate XXIII.



E. J. Manly, photo.

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PLATE XXIV.

FIGS. 1-2. HIBOLITES PISTILLIFORMIS (Blainville) Noetling. Ventro-dorsal and lateral aspects of two individuals (locs. 683 and 673). Nos. K. 33/683*a* and K. 33/674*a*. (Page 113).

FIGS. 3*a*,*b*. HIBOLITES sp. ind. Limestone (Jurassic ?), presumably below Belemnite Shales. 1¾ miles N. N. E. of Kuch (No. K. 33/703*a*). (Page 119).

FIGS. 4*a*,*b*. HIBOLITES SUBFUSIFORMIS (Raspail). Partly exfoliated example, resembling H. PISTILLIFORMIS, in ventro-dorsal and lateral aspects. 1½ miles N. N. W. of Kalabagh (No. K. 35/813*a*). (Page 111).

FIGS. 5-10. HIBOLITES aff. SUBFUSIFORMIS (Raspail). Six examples with comparatively long ventral groove. Loc. 763 (fig. 5 No. K. 35/763*a*); 776 (figs. 6-8 No. K. 35/776*a*'-*a*''.); 812 (fig. 9 No. K. 35/812*a*); and ROGERSITES beds (Valanginian) of Ambiky, Madagascar (fig. 10). (Page 111).

FIGS. 11-13. BELEMNOPSIS GERARDI (Oppel) Uhlig. Three fragments in ventral and lateral views. (Locs. 769 and 776). Nos. K. 35/776*a* and K. 35/769*a*. (Page 110).

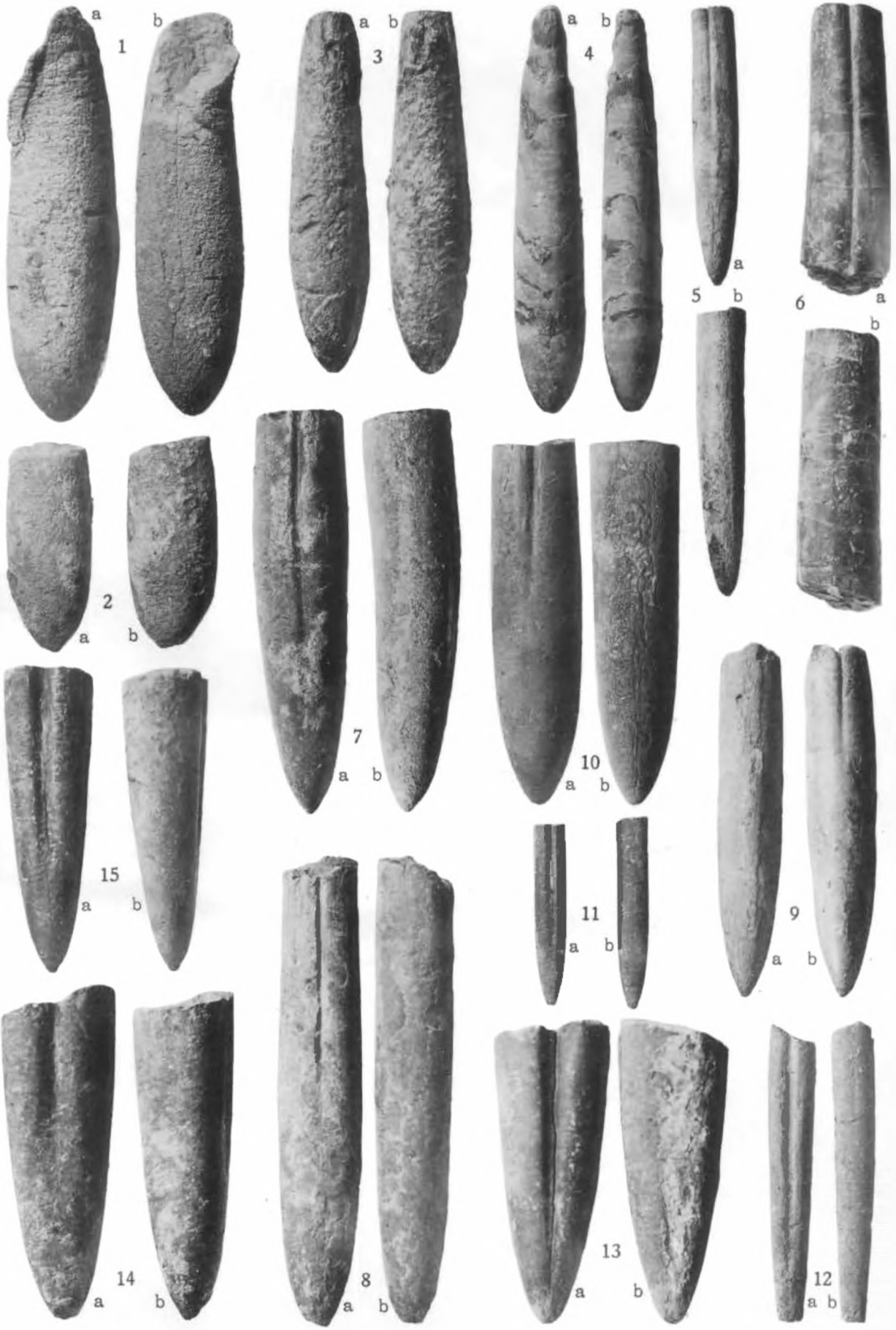
FIGS. 14*a*,*b*. BELEMNOPSIS sp. ind. Fragmentary guard of a depressed form with comparatively short ventral groove. (Loc. 776). No. K. 35/776*b*. (Page 110).

FIGS. 15*a*,*b*. BELEMNOPSIS AFRICANA (Tate). Ventral and lateral views of a fragmentary guard from the ROGERSITES Beds (Valanginian) of Ambiky, Madagascar. (H. Besairie Coll.). (Page 138).

All the specimens figured in this plate, except figs. 3, 10 and 15, are from the Belemnite Shales of the Salt Range and Trans-Indus Range.

Geol. Surv. of India

Plate XXIV



E. J. Manly, photo.

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PLATE XXV.

FIG. 1. The eastern slopes of Chichali Pass, Trans-Indus Range.

The strata form a sharp fold. In the centre of the fold the bedded Jurassic limestones, etc., occur. Above them are the dark coloured Belemnite Shales; the majority of the fossils were collected from the vertical outcrop near tributary nala of the right-hand half of the photograph. (Photo: E. R. Gee).

FIG. 2. The Mesozoic and Eocene sequence of the Miranwal gorge, near Makerwal, Trans-Indus Range.

In the foreground are the light coloured Upper Jurassic limestones followed above by the dark coloured Belemnite Shales. The latter are overlain by a massive Cretaceous sandstone (middle part of photograph) above which the thick Eocene limestones and shales form the precipitous upper slopes. (Photo: E. R. Gee).

Geol. Surv. of India. Plate XXV.

FIG. 1.

FIG. 2.

E. R. Gee, Photos. *G. S. I., Calcutta.*